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UNITED STATES DEPARTMENT OF THE INTERIOR

Information Circular 8748

Bibliography of Investment Costs, Operating Costs, and Related Economic Information for the Mineral Industries, January-December 1976

By L. A. Conley and J. Sabatini

March 3 1849

UNITED STATES DEPARTMENT OF THE INTERIOR
Cecil D. Andrus, Secretary

U.S. BUREAU OF MINES

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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BIBLIOGRAPHY OF INVESTMENT COSTS, OPERATING COSTS, AND RELATED ECONOMIC INFORMATION FOR THE MINERAL INDUSTRIES, JANUARY-DECEMBER 1976

by

L. A. Conley[1] and J. Sabatini[2]

INTRODUCTION

This report, covering the period January through December 1976, contains abstracts of articles related to cost engineering and economics for chemical and petroleum plants, mining, and other mineral industries from the following periodicals:

1. Air Pollution Control Association Journal
2. Chemical Engineering
3. Chemical Engineering Journal
4. Chemtech
5. Coal Age
6. Coal Mining and Processing
7. Combustion
8. Drilling-DCW
9. Electrical World
10. Engineering and Mining Journal
11. Engineering Economist
12. Hydrocarbon Processing
13. Journal of Metals
14. Journal of Petroleum Technology
15. Mechanical Engineering
16. Mining Congress Journal
17. Mining Engineering
18. Oil and Gas Journal
19. Petroleum Engineering
20. Pipeline and Gas Journal
21. Pit and Quarry
22. Power Engineering
23. Rock Products
24. Water and Sewage Works
25. World Coal
26. World Oil

In addition to the above periodicals, the Process Evaluation Office released the following Information Circulars in 1976 and early 1977:

Duda, J. R., and E. L. Hemingway. Basic Estimated Capital Investment and Operating Costs for Underground Bituminous Coal Mines Developed for Longwall Mining. Mines With Annual Production of 1.5 and 3 Million Tons by Longwall Mining From an 84-Inch Coalbed. BuMines IC 8715, 1976, 25 pp. Price $0.75; stock No. 024-004-01886-1.

_____. Basic Estimated Capital Investment and Operating Costs for Underground Bituminous Coal Mines Developed for Longwall Mining. Mines With Annual Production of 1.3 and 2.6 Million Tons by Longwall Mining From a 48-Inch Coalbed. BuMines IC 8720, 1976, 23 pp. Price $0.65; stock No. 024-004-01890-9.

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[1] Editorial assistant, Process Evaluation Office, Bureau of Mines, Morgantown, W. Va.

[2] Economist (now resigned).

Katell, S., E. L. Hemingway, and L. H. Berkshire. Basic Estimated Capital Investment and Operating Costs for Underground Bituminous Coal Mines. Mines With Annual Production of 1.06 to 4.99 Million Tons From a 72-Inch Coalbed. Revision of Information Circular 8632. BuMines IC 8682A, 1976, 41 pp. Price $1.05; stock No. 024-004-01828-3.

_____. Basic Estimated Capital Investment and Operating Costs for Coal Strip Mines. Revision of Information Circular 8661. BuMines IC 8703, 1976, 33 pp. Price $0.95; stock No. 024-004-01829-1.

Phillips, T. A. Economic Evaluation of a Process for Ferric Chloride Leaching of Chalcopyrite Concentrate. BuMines IC 8699, 1976, 22 pp. Available free.

_____. An Economic Evaluation of a Process To Separate Raw Urban Refuse Into Its Metal, Mineral, and Energy Components. BuMines IC 8732, 1977, 25 pp. Price $0.75; stock No. 024-004-01902-6.

Sabatini, J., and L. A. Conley. Bibliography of Investment Costs, Operating Costs, and Related Economic Information for the Mineral Industries, January-December 1975. BuMines IC 8716, 1976, 58 pp. Price $1.20; stock No. 024-004-01881-0.

Information Circular 8699 is available without cost from the Publications Distribution Branch, Bureau of Mines, 4800 Forbes Ave., Pittsburgh, Pa., 15213. All of the other Information Circulars listed are available from the Superintendent of Documents, Government Printing Office, Washington, D.C., 20402. There is a minimum charge of $1.00 for each order; please mention the stock number when ordering.

Most of the abstracts deal with construction and operating costs. Other subjects include cost-estimating methods and theory, reports on construction projects in the United States and abroad, developments in petroleum production and refining, and various energy sources.

Emerging energy sources--solar, nuclear, geothermal, and wind systems--are discussed in items 7, 20, 28, 58, 84, 119, 125, and 224. Costs for these developing forms of energy are usually compared with costs for conventional energy forms.

BIBLIOGRAPHY

A

1. Abramovitz, J. L. Economic Pipe Insulation for Cold Systems. Chem. Eng., v. 83, No. 23, Oct. 25, 1976, pp. 105-112.

Preventing cold-pipe sweating once outweighed other considerations in determining insulation thickness. Nomographs in this article are geared to selecting the thicker insulation now demanded by higher energy costs.

2. Adams, E. Energy Management Report: 30th Annual Report Survey. Petrol. Eng., v. 48, No. 6, May 1976, pp. EM 6, 8-9.

Federal and local governments receive more than a company keeps as earnings on common stock--before dividends are paid. Governments make more than all the shareholders of any gas company. A tabulation of financial statistics of 32 natural gas companies includes capital outlays for 1974, 1975, and 1976, return on equity, revenues, taxes, outstanding stock, fixed assets, long-term debt, etc.

3. Ahner, D. J., R. C. Sheldon, J. J. Garrity, and S. Kasper. Economics of Power Generation From Coal Gasification for Combined-Cycle Power Plants. Combustion, v. 47, No. 10, April 1976, pp. 26-35.

Equipment, operational characteristics, and costs associated with a large integrated coal gasification plant are discussed.

4. Auldridge, L. Iraq Development Grows Despite Severe Crude-Sales Slump. Oil and Gas J., v. 74, No. 33, Aug. 16, 1976, pp. 110-111.

A cash shortfall from a recent crude-production cutback is not expected to slow industry plans for expansion. Five key projects ahead in Iraq are identified.

B

5. Baba, T. B., and J. R. Kennedy. Ethylene and Its Coproducts: The New Economics. Chem. Eng., v. 83, No. 1, Jan. 5, 1976, pp. 116-128.

Ethylene is the backbone of the petrochemical industry. This report discusses the effects that price and availability of natural gas liquids have and will continue to have on this product. Capital and labor requirements are given in tabular form.

6. Bailly, P. A. The Problems of Converting Resources to Reserves. Min. Eng., v. 27, No. 1, January 1976, pp. 27-37.

Changes in the economy are creating problems for mineral producers.

Inflation and politics are changing more reserves to uneconomic resources. The author outlines an assessment of future raw material supply and defines weaknesses in economic theory as applied to minerals valuation.

7. Black, T. W. Megawatts From the Wind. Power Eng., v. 80, No. 3, March 1976, pp. 64-68.

Wind as a source of energy is increasingly attractive due to advancements in wind generator systems technology. Cost estimates are difficult because of the lack of hard data on which to base a decision; however, one estimate gives capital cost at $5,500 per kilowatt of generating capacity.

8. Blakely, J. W. Successful Mine Lighting Program Depends on Planning Economics. Coal Min. and Processing, v. 13, No. 10, October 1976, pp. 86-88, 106.

The price tag for lighting a section can range from $4,000 to $80,000, depending on the type of equipment, mine conditions, and sophistication of lighting arrangements. But better employee productivity and safety records can be achieved also.

9. Blanchet, M. J. Recovery of Methane Due From North California Landfill. Oil and Gas J., v. 74, No. 46, Nov. 15, 1976, pp. 82-85.

A project to collect, compress, and treat landfill gas is underway in northern California. Gas will be compressed, dehydrated, and stripped of carbon dioxide to produce a treated gas with a heating value of about 650 Btu/scf. Process cost estimates indicate that landfill gas at $2.57 per million Btu is competitive with liquid natural gas or synthetic natural gas from coal.

10. Bojnowski, J. J., R. M. Groghan, Jr., and R. M. Hoffman. Direct and Indirect Material Balance Control. Chem. Eng. Prog., v. 72, No. 9, September 1976, pp. 54-58.

This article discusses direct and indirect material balance control techniques in terms of their application to two distillation columns. Among the benefits of the improved control system are (1) operator training is easier, and (2) less operator time is required during feed changes.

11. Bossman, R. M. Spare Turbine Rotors Cut Costs and Reduce Outage Time. Power Eng., v. 80, No. 9, September 1976, pp. 50-51.

Higher costs of fuel, of purchased power, and for building and operating powerplants have added greatly to the value of having spare turbine rotors on hand. The benefits and savings are discussed.

12. Bowden, J. R. Prospects for Coal as a Direct Fuel and Its Potential Through Application of Liquefaction and Gasification Technology. J. Petrol. Technol., v. 28, January 1976, pp. 11-15.

Conversion of coal to clean fuels is reviewed. Costs are given in cents per million Btu for different processes.

13. Brooking, S. A., and A. R. Burgess. Present Worth of Interest Tax Credits. Eng. Economist, v. 21, No. 2, Winter 1976, pp. 111-118.

Interest credit on borrowed capital is not often considered in present worth studies. The authors develop an expression for the present worth of the interest components of a uniform repayment plan.

14. Burton, A. K. Capital and Operating Parameters for Off-Highway Trucks. Min. Eng., v. 27, No. 1, January 1976, pp. 38-41.

Capital and operating cost estimation for large off-highway trucks is discussed. The subject is presented in breakdowns into investment analysis using present worth, discounted cash flow technique, depreciation, maintenance, and indirect costs.

15. Butterworth, D., and L. B. Cousins. Use of Computer Programs in Heat-Exchanger Design. Chem. Eng., v. 83, No. 14, July 5, 1976, pp. 72-76.

By means of computer programs, many more parameters that affect flow conditions and heat transfer in an exchanger can now be taken into account than was previously possible using manual techniques. In addition, many more configurations may be tried to find a design that satisfies all the imposed constraints in the cheapest possible way. A tabular presentation gives the cost of several designs corresponding to the air-cooled heat exchanger example.

16. Bynum, D., Jr. Drilling Rig Cost Effectiveness. Petrol. Eng., v. 48, No. 11, September 1976, pp. 98, 102, 105.

Cost effectiveness and performance comparisons of drilling rigs show that electric rigs are competitive when total rig costs are considered. In example system discussed, cost of power equipment on DC rigs ranges from 20 to 44 percent more than cost of equipment on mechanical rigs; cost for SCR is 6 to 25 percent more than for DC.

C

17. Callihan, R. B. Improved Cementing Techniques for Large Diameter Casing. Drilling--DCW, v. 37, No. 13, October 1976, pp. 51-55.

Primary cementing of oil well casing strings has taken on added importance owing to higher rig costs and well equipment costs along with the high costs of remedial cementing for inadequate primary cementing jobs. Cementing large-diameter casing through drill pipe can save an hour or more rig time and can reduce excess cement costs (by 800 sacks, or $2,400, on a 1,000-foot casing string) compared with conventional casing cementing. Economic benefits and advantages can be extended to intermediate strings (9-5/8 to 13-3/8 inches) by substantially reducing rig time required to displace cement to bottom.

18. Cantrell, A. Worldwide Construction. Oil and Gas J., v. 74, No. 40, Oct. 4, 1976, pp. 112, 117-118, 120, 125-126, 128, 133-134, 139-140, 142, 145-146, 148, 151, 153, 155-156, 158, 161-162, 164, 166, 169-170, 175.

Major construction projects in worldwide processing and pipelining showing capacities, contractors, estimated costs, and time of completion.

19. Cantrell, C. J., Jr. Waste-Heat Recovery Cuts Plant Fuel Costs. Oil and Gas J., v. 74, No. 45, Nov. 8, 1976, pp. 183-186.

Rising fuel costs make fuel and energy conservation through waste-heat recovery attractive. Designed for the traditional 30- to 35-cent-per-million-Btu fuel gas, heaters are now subject to close scrutiny for revamp with fuel costs ranging from $1 to several dollars per million Btu. Payout time must be attractive, generally less than a year or two. With proper engineering and design, along with supervised and careful maintenance of equipment, waste heat may be used to cut overall fuel costs and to realize the maximum potential from any process.

20. Capener, E. L. The Economics of Solar Energy. Chemtech, v. 6, No. 3, March 1976, pp. 190-193.

This article compares a solar system for space and water heating with conventional gas and electrical heating systems. The basis for the comparison is a 15-year useful life for each alternative. Total energy cost per million Btu is calculated by amortizing the capital investment of each system over a 15-year life and adding to this the yearly maintenance and operating costs. Because of variations throughout the country in fuel costs and in the availability of solar energy, the cost comparisons are done for several regions.

21. Carinci, G. G., and D. C. Meissner. Direct Reduction Using Coal Gasification. Eng. and Min. J., v. 177, No. 10, October 1976, pp. 77-80.

Technology for direct reduction (using coal gasification) of iron ore has been successfully developed and commercially demonstrated by Midrex Corp. The expected range of capital costs for a facility to produce 420,000 metric tons per year of directly reduced product based on either of two coal gasification processes with the Midrex direct reduction process is $210 to $230 per annual metric ton.

22. Chao, S. K. M. Economics of Cement Transportation. Pit and Quarry, v. 68, No. 9, March 1976, pp. 67-69.

It has been estimated that 20 to 25 percent of the total cost of cement represents delivery costs. Bulk commodity logistics are discussed in detail, with particular emphasis on cement marketability.

23. Chemical Engineering. Jet Fuel From Coal: Feasible, but Costly. V. 83, No. 17, Aug. 16, 1976, p. 38.

Estimate prepared for the U.S. Senate Committee on Aeronautical and Space Sciences by Pullman Kellogg notes that a plant capable of liquefying 17,100 tons per day of coal to 9,400 barrels per day of jet fuel would require capital outlays totaling $780 million. To provide a 15-percent cash flow rate of return on investment, the manufacturer would have to sell the fuel for 76 cents per gallon.

24. _____. New Plants and Facilities...CE Construction Alert. V. 83, No. 7, Mar. 29, 1976, pp.

A summary of major chemical process industries projects announced from June to December 1975 as being in the planning stage, under construction, or newly completed in the United States, Canada, and Mexico is presented in tabular form. Tabulation is by company, product, location, capacity, and status and remarks.

25. _____. New Plants and Facilities...CE Construction Alert. V. 83, No. 20, Sept. 27, 1976, pp. 113-121.

A summary of more than 300 major chemical process industries projects announced from January to July 1976 as being in the planning stage, under construction, or newly completed in the United States, Canada, and Mexico is presented in tabular form. Tabulation is the same as that named in item 24.

26. _____. New Processes and Technology Alert. V. 83, No. 3, Feb. 2, 1976, pp. 101-111.

In this 40th inventory of new processes and technology, top technical developments in the chemical industries announced during May through October 1975 are listed.

27. _____. New Processes and Technology Alert. V. 83, No. 15, July 19, 1976, pp. 153-162.

In this 41st inventory of new processes and technology, top technical developments in the chemical industries announced during November 1975 through April 1976 are listed.

28. _____. Solar Power To Cast First Rays Into Utility Grid. V. 83, No. 21, Oct. 11, 1976, pp. 82-83.

A solar-powered experimental plant began to furnish electricity to an established electric utility system in France. The plant cost more than $1 million and is located in the French Pyrenees at Odeillo. This plant is expected to be followed with much larger projects. Mirrors have been ordered for a $30 million, 10-megawatt powerplant, which is due on stream in 1981.

29. _____. Water-Reuse Systems Star at Cincinnati AIChE Meeting. V. 83, No. 15, July 19, 1976, pp. 86, 88.

An economic evaluation showed a significant incentive for reuse versus disposal--a savings of more than $40 per 1,000 gallons for a 50,000-gallon-per-day unit--based on disposal estimates of 5 cents per gallon, 2-year membrane life, and electricity costs of 2.5 cents per kilowatt-hour. The proper mix of industrial, urban, and crop wastes, as well as needed markets for recovered substances, remain the key holdups to the large-scale use of the system.

30. Chemical Week. Activated Carbon Put to the Test. V. 119, No. 13, Sept. 29, 1976, p. 31.

A $22.4 million, 20-million-gallon-per-day tertiary treatment facility is being built at the Bound Brook, N.J., organic chemicals plant of American Cyanimid. This will be the largest industrial unit using activated carbon to purify waste waters. The plant is due for July 1977 startup.

31. _____. Bahia Gets Big Slice of CPI Pie in Brazil. V. 119, No. 2, July 14, 1976, pp. 43, 45, 47.

A $2 billion petrochemical complex has begun operation at Camacari, near Salvador, the capital of Bahia on Brazil's northeastern coast. Some units began operation in 1976, although the core unit--a 384,000-metric-ton-per-year ethylene plant--will not be completed until the first quarter of 1978. Thirty-two companies are committed to building plants in the complex.

32. _____. CPI Capital Spending Won't Be Profligate. V. 119, No. 15, Oct. 13, 1976, pp. 21-22.

Current plans of top companies in the chemical process industries point to steady but moderate growth. In some industries, notably electric utilities, the rise in plant and equipment outlays may be dramatic. Domestic plant expenditures will be huge, regularly exceeding 1976's estimated $22.5 billion, and are expected to climb through 1980. In terms of constant-value dollars, leading companies are budgeting plant investments to increase at about a 6-percent-per-year growth rate.

33. _____. CPI Cleanup Costs Hit New High. V. 118, No. 20, May 19, 1976, pp. 46-47.

Chemical industry capital spending in 1976 will include a record 11.2 percent for pollution control, which will push the 1976 planned environmental expenditures to a new high of $762 million, 37 percent more than the $556 million spent in 1975.

34. _____. CPI Plants Slow the Repair Cost Spiral. V. 119, No. 1, July 7, 1976, p. 30.

Maintenance costs rose 7.6 percent in 1975 after a 20-percent hike in 1974. Maintenance costs for 38 companies are tabulated.

35. _____. Ethylene Rally: Will It Last? V. 119, No. 13, Sept. 29, 1976, pp. 41, 44, 47-48.

Major ethylene producers predict a 7-percent annual market growth in their product through 1980, using 1974 as the base year. This growth rate will keep supply and demand in line. Some ethylene users believe this view is overoptimistic and contend demand growth will be at a more moderate rate. If it slips to 5 or 6 percent per year there could be substantial overcapacity unless some planned expansions are delayed.

36. _____. FBC May be a Better Way To Burn Coal. V. 119, No. 12, Sept. 22, 1976, pp. 24-28.

Fluidized-bed combustion is emerging as a promising new technology for converting coal to energy. It could be environmentally sound and cheaper and more efficient than ordinary firing.

37. _____. Hypochlorite Stacks Up Well Against NOX. V. 118, No. 9, Mar. 3, 1976, pp. 24-25.

Scrubbing powerplant stack gas with dilute solutions of sodium hypochlorite can remove oxides of nitrogen, including nitric oxide, according to the Stanford Research Institute (SRI), Menlo Park, Calif. SRI says the treatment is capable of removing 98 percent of NO_x, and adds only 70 cents per ton to the cost of coal burned in a 500-megawatt powerplant.

38. _____. Kremlin Escalates Antipollution Drive. V. 118, No. 10, Mar. 10, 1976, p. 52.

U.S. suppliers of technology and equipment stand good chance to benefit from Soviet plans to more than double outlays, to $14.5 billion, during 1976-80.

39. _____. Maleic Builds New Bridges to Feedstocks. V. 119, No. 15, Oct. 13, 1976, p. 79.

New maleic anhydride capacity coming on stream should go a long way toward answering a basic question: Is benzene or butane the better feedstock? Butane is winning backers, but benzene retains a big lead. For example, Ashland Chemical started a $20 million, 60-million-pound-per-year benzene-based plant at about the same time Amoco Chemicals started a butane-based plant with the same capacity. By July 1977 U.S. Steel Chemicals will double its present 40-million-pound-per-year capacity with a new benzene-based unit. Butane is gaining ground because it is a cheaper feedstock. At current prices the difference amounts to about 5 cents per pound of maleic anhydride.

40. _____. More Power for Uranium Enrichment. V. 119, No. 3, July 21, 1976, pp. 33-34.

New countries and consortiums are competing for a stake in the business overseas. Article includes some data on new plants and expansions.

41. _____. New Process Makes Coal Come Clean. V. 118, No. 1, Jan. 7, 1976, pp. 33, 35.

A process to remove most of the sulfur from coal before it is burned is being developed by Edgel Stambaugh of Battelle Memorial Institute of Columbus, Ohio. The cost of producing this coal is put at $10 to $15 per ton, which, added to the $30-per-ton cost of high-sulfur coal, would result in a fuel cost competitive with $11-per-barrel oil on the basis of Btu's delivered.

42. _____. New Solvent Has Big Appetite. V. 119, No. 24, Dec. 15, 1976, p. 31.

The first commercial installation of Cosorb, a process to recover carbon monoxide from a variety of chemical plant tail-gas streams, has been in use at Dow Chemical's Freeport, Tex., complex. With this successful operation as a starting point, Tenneco Chemicals, Saddle Brook, N.J., believes that the basic technology is useful, not only for recovering high-purity carbon monoxide, but for recovering ethylene as well. A general discussion includes other prospects, technology, and costs.

43. _____. No Cold Feet on Capital Spending. V. 118, No. 1, Jan. 7, 1976, pp. 10-11.

Chemical process industries set 1976 capital budgets at record highs. A tabulation of 34 companies shows capital expenditures for new plants and equipment for 1974 and 1975 and the planned expenditures for 1976. Allotments to foreign projects are also listed.

44. _____. Refreshing Change for Organic Wastes. V. 119, No. 2, July 14, 1976, p. 31.

Union Carbide is starting up a $1.1 million reverse-osmosis pilot unit at its Ponce, Puerto Rico, plant to test reuse of treated waste water from the multiproduct, integrated organic chemicals operation under a $270,000 grant from the Environmental Protection Agency. By the end of 1976, EPA should have a good idea of whether it will be economically possible to renovate and reuse waste waters from organic chemical plants. Operating cost for the 11,000-gallon-per-day pilot plant was estimated at about $850,000 for the 6-month test period.

45. _____. Researchers Vie for Cheapest TPA Route. V. 119, No. 15, Oct. 13, 1976, pp. 67-68.

Two experimental syntheses of terephthalic acid (TPA), a polyester feedstock, start with toluene instead of the more expensive *para*-xylene now used in most industrial processes. These two processes, one under joint development by Phillips Petroleum and France's Rhone-Poulenc S.A. and the other from Japan's Mitsubishi Chemical, are modifications of the Henkel II reaction in which the potassium salt of benzoic acid is converted into potassium terephthalate and benzene by heating at high temperatures. Cost of *para*-xylene is about 17 cents per pound, and toluene costs about 7 to 10 cents per pound.

46. _____. Spending Is Up, Foxud Is Sharper. V. 119, No. 17, Oct. 27, 1976, p. 21.

Executives of six major companies in the chemical process industries say their current capital spending programs are both larger and more selective than they were in the 1960's. Article gives capital expenditures for chemical and fertilizer operations; pulp, paper, and paperboard; and synthetic rutile and titanium dioxide plants.

47. _____. Tall Order in Waste Treatment. V. 119, No. 19, Nov. 10, 1976, pp. 67-68, 70.

Bayer has developed tower biology to improve oxygen utilization, save space and energy, and cut capital costs in treating wastes. Capital costs are reported as being as much as 20 percent lower, because vertical steel tanks are cheaper than horizontal concrete basins. Energy savings are reported as better than 50 percent.

48. _____. Technology Newsletter: Sulfur-From-Stack-Gas System Will Get $22-Million Test. V. 119, No. 2, July 4, 1976, p. 29.

Eight New York state utilities and the U.S. Environmental Protection Agency are cooperating in a 4-year, $22 million test of a sodium bicarbonate system for scrubbing sulfur dioxide from stack gas of powerplants burning high-sulfur coals and converting it into elemental sulfur.

49. _____. Urea Makers Can Strip Away Waste Problems. V. 119, No. 14, Oct. 6, 1976, pp. 33-34.

Urea plants use stripper towers to meet pending Environmental Protection Agency (EPA) standards. Technip SD Plants, New York, N.Y., says its units will reduce effluent urea and ammonia to 20 ppm. Conventional urea plants have effluent streams containing about 150 to 500 ppm. Eugene Hollis, sales manager for Technip SD Plants, puts capital investment for a typical hydrolyzer stripper system for a 1,000-short-ton-per-day urea plant finishing urea by prilling or granulation at about $1 million. An additional $500,000 would have to be invested if effluent from a 1,000-ton-per-day ammonia plant is added. Another process, Vistron, estimates capital costs at about $500,000 for a 700-ton-per-day plant, and operating costs at about 50 cents per short ton of urea, including steam and electricity.

50. _____. Vinyl Makers Ready To Clear Air. V. 118, No. 4, Jan. 28, 1976, p. 33.

With technology to meet proposed regulations, vinyl makers are ready to accept stringent limits on air emissions. Environmental Protection Agency pegged capital costs of control techniques for a 700-million-pound-per-year ethylene dichloride-vinyl chloride monomer plant at $889,000 to $355,000 for an incineration system plus items such as a multipoint vinyl chloride detector ($60,000), sample flask control system ($150,000), and dual mechanical seals on pumps and compressors ($91,000). Control costs for making suspension polyvinyl chloride resin in a 150-million-pound-per-year plant could be about $4.5 million.

51. Chender, M. Financing New Production in the Copper Industry Calls for New Approaches. Min. Eng., v. 28, No. 12, December 1976, pp. 20-23.

In 1955-70, the cost per metric ton of installed capacity for copper production rose from a range of $1,350 to $1,500 to a range of $2,900 to $3,400. By 1975 the cost had risen to $5,500 to $6,000. Near the end of 1976 it had reached an average of $6,500 to $7,000. This article discusses the capital needs of the industry and solutions to the problems of financing.

52. Christensen, D. R., and B. R. Conn. Advanced Wastewater Treatment Process Is Effective. Hydrocarbon Processing, v. 55, No. 10, October 1976, pp. 107-109.

Faced with a new challenge, Shell Canada devised a waste water treatment scheme and installed a new facility at the Waterton gas plant. Placed on stream in 1975, the plant has a capacity of 311 MMcfd. Facilities to handle the wastes were built at an expense of $4.3 million. Operating costs based on the first year's performance are given.

53. Clark, J. P. How To Design Chemical Plants on the Back of an Envelope. Part II. Facts and Their Interrelation. Chemtech, v. 6, No. 1, January 1976, pp. 23-26.

Part I of this series (November 1975, p. 664) described a simple procedure for preliminary chemical process evaluation. Part II presents a small collection of facts and relationships useful in the procedure described in part I. These not only give useful quantitative answer; they also identify unexpectedly costly operations at a stage at which they can be avoided.

54. Coal Age. Common Market Target Begs Capital Investment in Coal. V. 81, No. 11, November 1976, p. 53.

Common Market coal production will not meet its target of stabilizing at 250 million tons in 1985 if investment does not pick up. To meet production targets, the European Community needs to invest $600 million per year at 1973 prices. Survey shows that investment is being discouraged by poor short-term sales prospects, declining output per man-shift, and indecision on new coal-fired power projects.

55. _____. Operating Ideas: Large Pneumatic Crawler Drill Takes On Hard Rock at West Virginia Surface Mine. V. 81, No. 12, December 1976, p. 111.

An experiment using pneumatic crawler drills as a substitute for truck-mounted hydraulic rotaries in hard rock is said to be saving a West Virginia surface coal mining operator thousands of dollars daily. A section on analyzing costs discusses operating and capital costs.

56. _____. Trans Natal Outlines Plans for $230-Million Expansion. V. 81, No. 11, November 1976, p. 53.

South Africa's Trans Natal Coal Corp. has earmarked $230 million for three major projects. Half of the expenditure will go toward expanding the Matla colliery, one-third will go to the expansion of the Ermelo mines, and the balance will be used to purchase proved coal reserves previously held under prospecting permits.

57. Coal Mining and Processing. Million-Dollar Refuse Disposal System. V. 13, No. 12, December 1976, pp. 80-82.

Maple Meadow Mining Co. officials provided a cost breakdown on the various aspects of the refuse disposal system at their 1.25-million-ton-per-year deep mine near Beckley, W. Va. This company's experiences prove that refuse disposal is both a major initial investment and a continuing source of expenditures throughout the life of the underground mining operation.

58. Cole, G. F. Replication: One Way To Cost and Schedule Savings. Power Eng., v. 80, No. 7, July 1976, pp. 44-48.

Policies have been implemented that make it possible to use the replication option for building nuclear plants that are alike to a significant degree. Replication is estimated to save not less than 1-1/2 years in plant schedule, and also to cut the sunk cost during the early years to well below historical costs.

59. Collins, B. Iran's Refining and Petrochemical Expansion Begins To Set Fast Pace. Oil and Gas J., v. 74, No. 33, Aug. 16, 1976, pp. 76-79.

Iranian refinery development is being concentrated on the domestic market, where consumption grows rapidly. By 1980, about $3 billion will have been spent to meet this demand. Petrochemical expansion is aimed at replacing income that will be lost when crude revenues decline.

60. Congram, G. E. Additive System Controls Corrosion. Oil and Gas J., v. 74, No. 40, Oct. 4, 1976, p. 95-96.

Exxon Research & Engineering Co. has developed a new corrosion-control system which injects chemicals to cold crude feed. New units can be designed with all-carbon-steel overhead equipment. On a 100,000-barrel-per-day grassroots crude unit, substituting carbon steel for other alloys in the overhead can save $400,000 to $800,000, depending on design.

61. Cooper, D. O., and L. B. Davidson. The Parameter Method For Risk Analysis. Chem. Eng. Prog., v. 72, No. 11, November 1976, pp. 73-78.

This technique, often more effective than either Monte Carlo simulation or decision trees, provides quick results because computations can be performed with a desk calculator. Application of the method is illustrated for a capital investment example.

62. Crame, L. W. Cut Wastewater Treatment Costs. Hydrocarbon Processing, v. 55, No. 5, May 1976, pp. 92-94.

A rotating disk system for waste water treatment offers capital savings of $640,000 over an existing system that uses pretreatment and $920,000 over another system which uses an activated sludge treatment method. Economic comparisons are made in other areas.

63. Crow, P. Imports, Alaskan Crude To Tip U.S. Pipeline Choices. Oil and Gas J., v. 74, No. 44, Nov. 1, 1976, pp. 17-21.

The onset of North Slope production may shave U.S. imports demand in 1977, but its use by inland refiners ultimately may depend on the laid-in costs of foreign crude oil. Three West Coast-Midwest pipelines are proposed to ease a short-term Alaskan oil surplus on the West Coast and a crude shortage in the Upper Midwest caused by Canadian exports phaseouts. Long-term justification for any of them may depend on the future volume of overseas imports. Article includes map showing pipeline options for crude-short refiners, a tabulation of inland U.S. refiners' capability to produce sour crude, some laid-in crude costs, and one refiner's transportation cost figures.

64. Cummings-Saxton, J. Chemical-Industry Costs of Water Pollution Abatement. Chem. Eng., v. 83, No. 24, Nov. 8, 1976, pp. 106-113.

This article addresses the economic implications of water pollution abatement in compliance with the standards for effluent limitation specified in Public Law 92-500 (The Federal Water Pollution Control Act Amendments of 1972). The data were developed in a study sponsored by the National Commission on Water Quality. Tables furnish detailed information on investment, operation, and maintenance costs.

65. Curley, C. C., and P. Olesen. Martins Creek S.E.S.--800 MW-Unit 3 & 4. Design and Operating Experience With Axial Flow FD and ID Fans. Combustion, v. 48, No. 3, September 1976, pp. 23-29.

Design and operating experience with axial flow FD and ID fans at the Pennsylvania Power & Light Co. Martins Creek SES Units 3 and 4 is discussed. These units were designed for future installation of SO_2 removal equipment. An economic evaluation based on four combinations of fans is presented.

66. Curt, R. P. Economic Insulation Thickness. Hydrocarbon Processing, v. 55, No. 3, March 1976, pp. 137-138.

Return on investment analysis is used to illustrate how optimum insulation thickness for energy conservation is determined.

D

67. Danekind, W. E. Steam Management in a Refinery. Hydrocarbon Processing, v. 55, No. 12, December 1976, pp. 71-74.

About 10 percent of the crude oil refined is used as fuel. About 33 percent of the fuel is used to make steam. In a 100,000-barrel-per-day refinery, a 10-percent fuel reduction will save $1.2 million per year.

68. Davis, R. L. Increase Anchor Reliability, Cut Costs. Electrical World, v. 186, No. 3, Aug. 1, 1976, p. 43.

Electric power system distribution involves networks of wiring and anchor installations. Consumers Power Co. has a new anchoring technique that reduces costs considerably. Labor costs are also reduced.

69. Dinkel, J. J., G. B. Kleindorder, G. A. Kochenberger, and Shek-Nam Wong. Environmental Inspection Routes: An Operations Research Analysis. J. APCA, v. 26, No. 12, December 1976, pp. 1170-1171.

This is a description of a plant inspection planning system and a report on its uses, costs, and results. Costs of operating the system are broken down into three categories--data preparation, storage, and execution time.

70. Doherty, M. C. Selection of Boiler Steam Conditions for Industrial Power Plants. Combustion, v. 47, No. 7, January 1976, pp. 12-19.

Optimum boiler steam conditions in industrial powerplants conserve energy and cut fuel costs. The effects of higher boiler steam pressures and temperatures on the performance and overall economics of inplant power generation are discussed. Capital and operating costs are given, and different methods of economic evaluation are outlined.

71. Drilling--DCW. Drilling Costs Climbing Faster Than General Inflation. V. 38, No. 2, December 1976, p. 26.

A comparison of an index of drilling costs per foot and several familiar inflation yardsticks shows that drilling costs increased faster than general inflation in 12 of the 16 years since 1959. Payments to drilling contractors rose 150.7 percent during 1965-75, with almost two-thirds of the rise occurring in 1973-75. Casing and tubing costs increased 157.4 percent since 1965 with more than one-half of the increase occurring in 1973-75.

72. Dumont, A. E., and V. S. Purdy. Use of Seismic Data Can Cut Arctic Drilling Costs. World Oil, v. 182, No. 1, January 1976, pp. 71-74.

In frontier drilling areas, geophysical data are important tools in planning drilling programs since information from offset wells is seldom available. By using seismic interval velocity profiles, Gulf Oil Canada has been able to predict troublesome drilling areas and abnormally high pressures in addition to reducing drilling costs through better utilization of bits and casing.

E

73. Edison, R. R., J. O. Siemssen, and G. P. Masologites. Crude and Resid Can be Cat-Cracker Feeds. Oil and Gas J., v. 74, No. 51, Dec. 20, 1976, pp. 54-60.

A process to remove metals deposited from the feedstock on catalytic cracking catalyst makes it possible to economically "crack the bottom of the barrel." The process, known as Demet III, developed by Atlantic Richfield, is a low-cost chemical and physical treatment which removes metals from either zeolitic or amorphous cracking catalysts.

74. Electrical World. Finance: Pollution Controls: The Cost. V. 185, No. 9, May 1, 1976, p. 7.

Gordian Associates, New York, N.Y., and ICF inc., Washington, D.C., recently came to some interesting conclusions concerning rhe cost of pollution controls for coal-fired utilities. It costs 50 percent more to remove 99 percent of particulates from stack emissions than to remove 95 percent. Low-sulfur oil is estimated to cost $12 per barrel, or $2.05 per million Btu. Low-sulfur western coal is estimated to cost $16 per ton, or 95 cents per million Btu. The cost of eastern low-sulfur coal is estimated to be $26 per ton, or $1.10 per million Btu. Data in the study were prepared for the Michigan Public Service Commission.

75. _____. Maintenance 76: Repair Costs Reach $3.3 Billion. V. 185, No. 6, Mar. 15, 1976, pp. 60-61.

Costs of maintenance for U.S. utilities rose rapidly through 1975. Maintenance of generation facilities accounts for about 53 percent of the total and was up 25 percent in 1975 from 1974. Transmission, distribution, and miscellaneous cost features are analyzed.

76. _____. Polyurethane Foam Insulation Proves Out. V. 186, No. 9, Nov. 1, 1976, pp. 42-43.

Sprayed-on urethane foam insulation is achieving significant fuel savings at the coal preparation station for Pennsylvania Power & Light's Montour generating plant. A seamless, 1-inch-thick layer of urethane foam, sprayed on the coal-dryer system's ductwork and associated enclosures, is expected to save the utility about $73,800 per year at current coal prices. Some information and costs are also given for urethane on fire and water tanks.

77. Elwes, P., and J. Johnson. Role of FPF's in the North Sea. Petrol. Eng., v. 48, No. 12, October 1976, pp. 42, 50, 52, 55.

A floating production facility (FPF), suitable for developing

North Sea fields economically, will cost $1,100 to $1,500 per daily barrel of production. The system also reduces production leadtime.

78. Engineering and Mining Journal. St. Joe Minerals: Growing Through Diversification. V. 177, No. 11, November 1976, pp. 69-77.

This article reports on past and future growth of St. Joe Minerals Corp. Many of their mines, smelters, plants, and mills are identified; capital investments and expenditures are given. Other subjects discussed include production costs, marketing, and environmental conservation.

79. Ewing, R. C. Colonial Is Expanding Products System With 183-Mile Line. Oil and Gas J., v. 74, No. 40, Oct. 4, 1976, pp. 90-94.

Colonial Pipeline Co. is adding an $88 million, 182.7-mile-long, 40-inch-diameter looping line to its products-pipeline system. Completion is expected by the end of 1976. This expansion, the sixth since the original system was installed in 1963, is expected to increase the system's capacity by 12 percent.

80. _____. Pipeline Economics. Oil and Gas J., v. 74, No. 34, Aug. 23, 1976, pp. 77-120.

The 19th annual report on pipeline installation and equipment costs includes articles dealing with (1) offshore compressor station approved, (2) firms propose east coast liquefied natural gas plant, (3) products, crude-line investment up, (4) completed pipeline costs, (5) 10-year construction cost trend, (6) pipeline equipment cost index, (7) completed compressor station costs, (8) offshore and onshore gas pipeline projects, (9) liquid pipeline projects, (10) new underground gas storage due, and (11) U.S. pipeline operations increased. Material is presented in both tabular and graphic form.

F

81. Fay, H. P., C. A. Brown, M. S. Yao, and R. A. Molina. Advanced Techniques Minimize Wet-Dry Tower Costs and Water Consumption. Combustion, v. 48, No. 4, October 1976, pp. 23-27.

Increasing environmental concern and diminishing water supplies have introduced the need for improved and more comprehensive cooling system evaluation capabilities in planning for plant and siting alternatives. A circulating water system optimization program developed by Kaiser Engineers in association with General Atomic Co. is described.

82. Ferretti, E. J. Basic Considerations in Coal Liquefaction. Coal Min. and Processing, v. 13, No. 3, March 1976, pp. 55-57.

Cost of liquid fuels from coal is given a range of $15 per barrel to $23 per barrel. With the value of crude oil at $13 per barrel, the suitability of synthetics is apparent for the future.

83. Fick, J. E. U.S. Benzene Supply/Demand to 1985. Chem. Eng. Prog., v. 72, No. 11, November 1976, pp. 26-29.

This article discusses the following questions: What will the demand for benzene be by 1985? What will be the sources of supply? How much will it cost to produce? A table lists some of the new plants that must be built if the forecasts for future supply and demand are to be realized. Availability of capital may be the biggest problem in accomplishing this building program.

84. Fine, H. A., and T. M. Lambright. Solar Energy in the Metallurgical Industries: An Overview. J. Metals, v. 28, No. 6, June 1976, pp. 14-16.

Detailed process information and costs are presented and compared with those of conventional forms of energy. Several examples are presented to illustrate why solar energy is not the panacea for metallurgical energy needs.

85. Freireich, E., and R. N. Tennyson. Process Improves Acid-Gas Removal, Trims Costs, and Reduces Effluents. Oil and Gas J., v. 74, No. 34, Aug. 23, 1976, pp. 130-132.

Gas-treating plant developments have reduced capital and operating costs, lowered energy consumption, and diminished effluents.

G

86. Gans, M. Which Route to Aniline? Hydrocarbon Processing, v. 55, No. 11, November 1976, pp. 145-150.

Tabulation in this article presents a summary of capital and operating costs for two aniline processes starting from benzene, and in addition for aniline from phenol using the Halcon process. Plant capacity in each case is 200 million pounds per year. Process descriptions are given.

87. Garcia-Borras, T. Research-Project Evaluations (Part 1). Hydrocarbon Processing, v. 55, No. 12, December 1976, pp. 137-138, 140-141, 144, 146.

In a study of 55 articles, books, and reports, the author arrived at this summary of methods and tools that others have found advantageous. Tables show (1) research and development activities and supporting data, (2) types of cost estimates, (3) quick ways to estimate capital investment and operating costs, (4) common terminology used in cost estimating, (5) growing pains in going from research to commercialization, (6) accuracy of cost estimates, (7) determination of selling price, (8) cost estimate of bench-scale process order of magnitude, and (9) evaluating the project. Part 2 of this report is in the January 1977 issue.

88. Gard, P. J., H. J. Maxwell, and J. F. Mullowney. Preparing Bituminous Coals for Gasification. Coal Min. and Processing, v. 13, No. 9, September 1976, pp. 61-64.

An analysis of the effect of various preparation techniques on the gasification of bituminous coals points out that cost benefits from coal preparation can be very significant. Because any form of moisture removal from coal tends to be costly, a trade-off study must be performed to determine the optimum amount of moisture reduction that should be attained prior to gasification.

89. Gearhart, J. A., and L. Garwin. Resid-Extraction Process Offers Flexibility. Oil and Gas J., v. 74, No. 24, June 14, 1976, pp. 63-66.

A new supercritical solvent process produces high yields of oil from heavy residuals, waxy stocks, and reduced crudes. The process can save the refiner 50 percent in utility costs and nearly 20 percent in required capital investment. The process, developed by Kerr-McGee, is known as the ROSE (residuum oil supercritical extraction) process. Using typical costs for power, fuel, and water, utility savings of up to $1.4 million per year can be shown for a 10,000-barrel-per-stream-day ROSE unit.

90. Grancher, R. U.S. Cement or Whose? Rock Products, v. 79, No. 4, April 1976, pp. 128-134.

The U.S. cement industry faces difficulties in the form of economic constraints. Return on investment estimates are insufficient to justify additional capacity. Pollution control is also a major constraint hurting the industry.

H

91. Hale, D. Bi-Gas Pilot Plant Officially in Operation. Pipeline and Gas J., v. 203, No. 13, November 1976, pp. 42, 44.

The largest coal gasification pilot plant in the United States, the $66 million Bi-Gas facility at Homer City, Pa., is officially in operation. The article includes a schematic diagram of the Bi-Gas process, which was developed by the Bituminous Coal Research, Inc. A fact sheet lists costs and details of the pilot plant and gives $1 billion as the estimated cost for a 250-MMscfd commercial plant.

92. _____. Peakshaving Supplies in Good Shape for 1976-77 Winter Season. Pipeline and Gas J., v. 203, No. 13, November 1976, pp. 17-19.

Gas transmission and distribution companies continue to expand peak shaving supplies, especially underground gas storage. Expenditures of $244.9 million for underground storage facilities were reported by 35 companies during 1976, and total investment in underground gas storage is now in excess of $2.8 billion. For 1977, 33 companies report they plan expenditures of $237.6 on storage development. No problems are seen in meeting 1976-77 winter peak demands, even though there will be a "shortfall" in gas supplies for many industrial and interruptible customers.

93. _____. Trans-Alaska Oil Pipeline Moves Toward Completion. Pipeline and Gas J., v. 203, No. 11, September 1976, pp. 21-26, 28, 37.

Alyeska Pipeline Service Co. intended to have the pipeline portion of its $7.7 billion project completed by November 1, 1976. By April 1977, work is expected to be completed on the line's pump stations to provide the minimum 600,000-barrel-per-day capacity, along with storage, docking, and operational facilities at the Valdex terminal site, plus the 148-mile fuel gas line from Pump Station 1 to Pump Station 4. The official "starting date" for an operational trans-Alaska oil pipe line carrying crude oil from the Prudhoe Bay field on the Alaskan North Slope is July 1, 1977.

94. Halvorsen, W. J. Slurry Pipeline Hydraulics Improved. Oil and Gas J., v. 74, No. 12, Mar. 22, 1976, pp. 62-66.

Cleaning coal before pipeline slurrying requires additional investments in filtration and drying systems as well as size reduction equipment, centrifuges, and other machinery. Capital and operating costs are given.

95. Hammett, J. L., Jr., and L. A. Lindsay. Advanced Computer Control of Ethylene Plants Pays Off. Chem. Eng., v. 83, No. 24, Nov. 8, 1976, pp. 115-120.

In naphtha-fed plants, the authors see a 100-percent return on investment (discounted cash flow) for placing the furnace and recovery sections and the overall material balance under advanced computer control. Benefits include improved yield reporting and regulation, reduced reprocessing and overfractionation, lessened material losses via vent gases, and more efficient use of feeds, energy, and utilities.

96. Haugen, A. K., and I. L. Purdy. Coating Waterflood Supply Line Stops Corrosion and Reduces Horsepower. Oil and Gas J., v. 74, No. 26, June 28, 1976, pp. 148-150, 155.

Inplace epoxy coating of a waterflood-transmission line has effectively stopped the corrosion mechanisms which had been operating. Other benefits have been a cut in chlorine consumption of about 65 percent for a 12-month saving of about $12,000, and a 10- to 15-percent reduction in total horsepower requirements. The completed cost, including all incidentals, to clean and coat a 14-mile line was $1.27 per square foot of surface area for a completed project cost of $325,000.

97. Heard, T. C. Gas Pipelines' Fuel Costs Reduced. Oil and Gas J., v. 74, No. 38, Sept. 20, 1976, pp. 195-198.

Value of natural gas in transmission systems is rising fast. By 1980, it may cost an average of $2 per MMBtu for compressor fuel in the United States. A number of changes in standard gas turbine station practice to improve fuel economy may merit consideration. Tables show economics of evaporative cooling, installed-cost comparison of gas turbine and steam injection stations, and a comparison of installed and operating costs of the combined cycle and a regenerative cycle gas turbine.

98. Heaton, L. S., and E. J. Smet. New Approaches Help To Cut Energy Use. Oil and Gas J., v. 74, No. 33, Aug. 16, 1976, pp. 134-135.

With the increased cost of fuel, a substantial amount of equipment can be justified for waste heat recovery. At 2 cents per kilowatt-hour, 100 horsepower recovered is a savings of $12,000 per year. Reducing steam consumption by 2,000 pounds per hour can save $32,000 per year at $2 per 1,000 pound.

99. Herbert, V. D., Jr., and A. Bisio. The Risk and the Benefit: Part 1. Price. Chemtech, v. 6, No. 3, March 1976, pp. 174-179.

Part 1 of a two-part article discusses ways a price can be and is expressed, price information sources, and overall factors influencing price.

100. _____. The Risk and the Benefit: Part 2. Venture Analysis. Chemtech, v. 6, No. 7, July 1976, pp. 422-429.

Part 2 of this two-part series describes the process of economic analysis from an idea to a venture analysis. Examples are cited, and figures and tables are used to present much of the cost information.

101. Herod, B. C., and J. G. Kostka. Aggregates, Other Major Non-Metals. Pit and Quarry, v. 68, No. 7, January 1976, pp. 66-80.

Labor and maintenance cost changes are given for production of sand, gravel, and crushed stone through 1975. Costs and other aspects of minerals production are viewed for limestone, aggregates, slag, and other materials.

102. Hess, M. Ammonia: Coal Versus Gas. Hydrocarbon Processing, v. 55, No. 11, November 1976, pp. 97-101.

For the United States, an overall approach to ammonia production economics shows that basing new ammonia and methanol plants on coal-based synthesis plants and converting existing plants over the next 5 years could make 1 billion scfd of natural gas available for home and commercial use. Investment and production costs are given.

103. Hetherington, C. R. High Arctic Challenge and Potential. Petrol. Eng., v. 48, No. 2, February 1976, pp. 19-22.

Oil and gas exploration costs are discussed for the high Canadian Arctic. It is estimated that a 10,000-foot well costs approximately $2.5 to $4 million owing to difficult terrain and harsh climate.

104. Hoerner, G. M., Jr. Nomograph Updates Process Equipment Costs. Chem. Eng., v. 83, No. 11, May 24, 1976, pp. 141-143.

A nomograph to correct process and equipment cost data for both elapse of time and difference in size or capacity provides a quick, convenient means of estimating costs.

105. Howland, J. W. Keep These Cost Factors in Mind When Making Important Economic Decisions. Coal Age, v. 81, No. 4, April 1976, pp. 224-226.

Costs are given for owning and operating heavy equipment used in reclamation of strip-mined lands. Depreciation, interest, insurance, and taxes are also reviewed.

106. Hudached, R. J., and V. R. Dodd. Refinery-Machinery Surveillance and Diagnostic Program Pays Off. Oil and Gas J., v. 74, No. 42, Oct. 18, 1976, pp. 70, 75-81.

After establishment of a machinery surveillance and diagnostic program in a major refinery of Chevron Oil Co., maintenance costs have been reduced by 22 percent for large machines and up to 30 percent for smaller machines.

107. Huff, G. A., Jr. Selecting a Vacuum Producer. Chem. Eng., v. 83, No. 6, Mar. 15, 1976, pp. 83-86.

This article examines the economics of choosing a vacuum producer for use in chemical processes. Steam jet and mechanical pumps are the two types considered.

108. Hughes, J. W. Using Availability Figures To Schedule Truck/Loader Replacement. Min. Eng., v. 28, No. 10, October 1976, pp. 44-45.

During any truck-loading operation, it will become necessary to replace hauling and loading units. Timing of replacement based on a planned schedule derived from past performance records can reduce overall costs and keep breakdowns within reason. This article presents figures and tables to support a discussion of maintenance costs and equipment availability.

109. Hydrocarbon Processing. New Ethanol Dehydration Process. V. 55, No. 11, November 1976, p. 21.

A new fluidized-bed process for dehydration of ethanol can reduce plant investment and operating costs, according to C-E Lummus, which evaluated and pilot-plant-tested the method. A table compares preliminary economic data for a fixed-bed and a fluid-bed version of a 60,000-metric-ton-per-year ethylene-from-ethanol plant. Investment cost for the fluid-bed system is $5.6 million, compared with $11.9 for the fixed-bed system.

110. _____. 1976 Refining Process Handbook. V. 55, No. 9, September 1976, pp. 103-230.

This handbook contains up-to-date descriptions of processes that are important to the modern refiner for making fuels, lubricants, asphalts, and waxes. Most descriptions contain literature references where more detailed information can be found. An index includes both specific proprietary names and broad processing categories. Processes are grouped for easy comparison. A section on economics is included for most of the processes.

111. _____. World-Wide HPI Construction Boxscore. October 1976.

Hydrocarbon processing industries projects recently completed, under construction, and in the planning stage are presented. Capacities and locations are listed.

I

112. Iammartino, N. R. Beneficiated-Ilmenite Process Recycles Process HCl Leach Liquor. Chem. Eng., v. 83, No. 11, May 24, 1976, pp. 100-101.

Hydrochloric acid leaching technique beneficiates ilmenite ore to a feedstock suitable for the environmentally clean chloride route to titanium dioxide--via a closed-loop system that avoids creating pollution woes of its own. Battery-limits capital cost for a plant turning out 100,000 metric tons per year of Benilite, based on 1975 costs and a U.S. gulf coast location, totals approximately $32 million. Operating data are given, and a table lists six commercial plants that will make Benilite by 1979, giving plant owner, location, capacity, and startup date.

J

113. Janoso, R. P. Baghouse Operating Experience With Coal Firing. Power Eng., v. 80, No. 10, October 1976, pp. 62-64.

The first full-scale baghouse on a coal-fired boiler went into operation in February 1973. Its success stems from design features such as low air-to-cloth ratio, low inlet velocity, and method of cleaning, couples with careful material selection and good operating procedures.

114. Jelen, F. C. Pitfalls in Profitability Analysis. Hydrocarbon Processing, v. 55, No. 1, January 1976, pp. 111-115.

Evaluation of profitability has, in the past, regarded capital and operating costs and nonengineering items such as price as two discrete assessments. The author suggests that this is no longer possible. Complications and pitfalls that the evaluator must consider are discussed.

115. Jimeson, R. M. Solvent-Refined Coal Keeps Flue Gas Clean. Chem. Eng., v. 83, No. 5, Mar. 1, 1976, pp. 80-81.

The solvent-refined coal process producing low-sulfur, low-ash coal is an effective method of controlling sulfur oxide emissions. Capital investment, costs, and economics are discussed.

116. Johnson, C. D. Modern Radwaste Systems: An Overview. Chem. Eng. Prog., v. 72, No. 3, March 1976, pp. 43-46.

A cost comparison of two types of nuclear waste storage containers is presented.

117. Jones, K. C. Utilities Control Center Is Energy-Information System. Oil and Gas J., v. 74, No. 49, Dec. 6, 1976, pp. 91-92, 94.

The utilities-control center at Shell Oil Co.'s Deer Park, Tex., manufacturing complex functions as a computer-based energy-information system which has contributed much to a safer, more efficient, and more profitable operation. Four examples highlight specific ways in which the utilities control center is profitable.

118. Jordan, D. R., W. F. McIlhenny, and G. T. Westbrook. Cooling Tower Effluent Reduction by Electrodialysis. Combustion, v. 48, No. 4, October 1976, pp. 28-32.

The authors describe a technology capable of removing salt from a cooling tower circuit, hence increasing the recovery of available water. The process is discussed, and an appendix gives the level of operating costs that may be expected. Operating cost for the case illustrated would be 0.0893 mill per kilowatt-hour. Design was based on four 1,000-megawatt plants with an 80-percent load factor.

K

119. Keplinger, C. H. OPEC Oil Price Enhances U.S. Geothermal Development. World Oil, v. 183, No. 2, Aug. 1, 1976, pp. 45-48.

Geothermal energy is presented as an attractive domestic energy source. At The Geysers, a geothermal field located 80 miles north of San Francisco, Calif., the installed steam generating capacity is 522,000 kilowatts (520,000 kilowatts net). Equivalent energy from imported oil would require 7,500,000 barrels of oil and would cost about $100 million. As shown in an accompanying economic analysis, net cash return at 2 cents per kilowatt-hour is estimated at $244,610,000 during the first 20 years of production. The actual price per kilowatt for steam will probably average between 1 and 2 cents during the first 5 years of producing life.

120. Kiguchi, I., T. Kumazawa, and T. Nakai. For EO: Air and Oxygen Equal. Hydrocarbon Processing, v. 55, No. 3, March 1976, pp. 69-72.

Cost factors are analyzed for determining whether to use air or oxygen in the manufacture of ethylene oxide. Capital investment figures are given for different plants.

121. Kirschke, R. H., S. Kartar, and C. Chen. Capital Cost Variation Experience in Power Plant Construction. Power Eng., v. 80, No. 2, February 1976, pp. 60-63.

Factors that influence utility capital costs are divided into two categories--controllable variables and uncontrollable variables. Other less significant factors are included in the discussion, and charts are used to illustrate cost variance.

122. Kuhre, C. J., and C. L. Reed. Shell Noncatalytic Gasification Process Leads to SNG. Oil and Gas J., v. 74, No. 2, Jan. 12, 1976, pp. 110-118.

Capital costs are estimated for a noncatalytic gasification process developed by Shell Oil Co. The process can use any fluid hydrocarbon as feedstock. Total investment for a 250-MMscfd plant is estimated at $500 million. Operating costs are also given.

123. Kupchik, G. J., and G. J. Fronz. Solid Waste, Air Pollution, and Health. J. APCA, v. 26, No. 2, February 1976, pp. 116-118.

The social costs of industrial activities are sometimes difficult to measure in dollars. Spillover costs to society caused by environmental pollution are one example. The authors reveal an attempt to compute these costs, stating that total savings resulting from a 50-percent reduction in air pollutant levels would approach $2 billion per year.

L

124. Lamp, G. E. Treatment of Deferred Taxes and Unamortized Investment Tax Credit in the Revenue Requirement Equation. Eng. Economist, v. 21, No. 2, Winter 1976, pp. 79-88.

Privately owned public utilities are regulated by Government on the overall revenues they are permitted to earn. The author illustrates how deferred taxes and investment tax credits should be treated in determining revenue requirements for a utility company.

125. Lengquist, R., and F. Hirschfeld. Geothermal Power: The "Sleeper" in the Energy Race. Mech. Eng., v. 98, No. 12, December 1976, pp. 26-31.

Geothermal power is relatively cheap, there are no safety problems, few environmental headaches, and little new technology to develop or prove. The installation at The Geysers in northern California shows what can be done to harness this potential source of energy. A section on economics states that it has been commercially practical to generate power from geothermal steam at The Geysers because it can be produced economically in comparison with power from other sources in the Pacific Gas and Electric system. Capital costs are given.

126. Lewis, P. J. Efficient, Nonpolluting Ethylbenzene Process. Chem. Eng., v. 83, No. 1, Jan. 5, 1976, pp. 90-91.

A new pollution-free process for making ethylbenzene has been developed as a joint effort by Mobil Oil Co. and The Badger Co., Inc. Capital and operating costs are discussed.

127. Long, M. Austin Chalk Play Spreads Far to Northeast in Texas. Oil and Gas J., v. 74, No. 36, Sept. 6, 1976, pp. 60-64.

A major operator claims that the chalk play has the potential of becoming "as large a producer as East Texas field" if the industry can get the oil out. An engineer estimates that there are 400 million barrels of oil in the trend, figuring 60 feet of net pay and 2,640 barrels per acre. The key to future growth is economics.

128. _____. Deep Cretaceous Gas Play Heats Up in S. Louisiana. Oil and Gas J., v. 74, No. 51, Dec. 20, 1976, pp. 15-18.

Five wells have been completed in an 8-mile chain in the False River gasfield in Pointe Coupee and West Baton Rouge Parishes, La. Initial test rates are up to 20 million cubic feet per day. Development costs are given.

129. _____. Hot Ozona-Sonora Play Still Expanding. Oil and Gas J., v. 74, No. 24, June 14, 1976, pp. 29-30, 32.

Operators are expected to spend as much as $120 million in 1976 to drill 525 or more wells in gas play stretching over portions of nine southwest Texas counties.

Mc

130. McClaskey, B. M., and J. A. Lundquist. Can You Justify Hydraulic Turbines? Hydrocarbon Processing, v. 55, No. 10, October 1976, pp. 163-166.

A hydraulic power recovery turbine (HPRT) is a centrifugal pump modified mechanically to operate with reverse rotation. It can recover up to 80 percent of the fluid's energy. Any continuous process where high-pressure liquid is let down across a pressure-reducing device is a potential application for the HPRT. Cost and payout are discussed.

131. McKinlay, W. North Sea Maintenance Costs and Considerations. Petrol. Eng., v. 48, No. 6, May 1976, pp. 132, 134.

It is estimated that by 1980, $250 million may be spent on materials and labor in the maintenance of offshore structures in the North Sea. Tables show the number of platforms already installed and currently under construction for the northern sector and the predicted labor and material costs for 1980 offshore maintenance.

M

132. Mason, R. H. Wet Roof Bolting Looks Promising. Coal Min. and Processing, v. 13, No. 11, November 1976, pp. 68-70.

Test applications at the Olga mine of a system designed by FMC Corp., Mining Equipment Div., show that "wethead" bolting can cut drill bit costs in half. The process is still in the experimental stage, but the theory is considered sound since cooling action would reduce heat, prevent bit destruction, and allow continuation of the cutting action.

133. Meisel, S. L., J. P. McCullough, C. H. Lechthaler, and P. B. Weisz. Gasoline From Methanol in One Step. Chemtech, v. 6, No. 2, February 1976, pp. 86-89.

Although present economics are not particularly attractive, Mobil's breakthrough route to high-octane gasoline is promising. While gasoline made by any coal conversion method cannot compete at present with gasoline made from crude oil, the economics of the 1980's may be more favorable.

134. Meyer, W. S., and D. L. Kime. Cost Estimation for Turbine Agitators. Chem. Eng., v. 83, No. 20, Sept. 27, 1976, pp. 109-112.

Power and speed are presented as the primary factors affecting the cost of turbine agitators. Effects of number of impellers and materials of construction on the estimated cost of complete systems are also considered.

135. Mining Engineering. Report Says Ocean Mining Can be Viable Alternative to U.S. Imports of Key Minerals. V. 28, No. 10, October 1976, p. 11.

Commercial recovery of manganese nodules from the deep ocean floor promises to be economically attractive and competitive with other new mineral extraction projects, according to a study prepared by the Department of the Interior's Ocean Mining Administration (OMA).

136. Mol, A., J. Drasisma, and B. de Moet. Heavier Cracker Feedstocks Increase Problems With Sulfur. Oil and Gas J., v. 74, No. 31, Aug. 2, 1976, pp. 104-106, 111, 114, 119-120.

A trend toward heavier feedstocks for ethylene production leads to problems in cracker design and product quality because of the higher sulfur content of these feedstocks. Tables show hydrodesulfurization operating costs for atmospheric gas oil (AGO) and vacuum gas oil (VGO).

137. Monroe, E. S. Select the Right Steam Trap. Chem. Eng., v. 83, No. 1, Jan 5, 1976, pp. 129-134.

Consideration is given to the high maintenance costs associated with steam traps in chemical process plants. Corrosion and other problems cause maintenance difficulties.

138. Moore, J. G., Jr. Wastewater Requirements Multiply Solids Problem. Hydrocarbon Processing, v. 55, No. 10, October 1976, pp. 98-101.

Tougher regulations increase solids treatment cost geometrically. Four figures present costs and performance for various levels of treatment, industry costs for water pollution abatement, solid sludge generation as a result of increasing pollution abatement, and solid waste disposal alternatives. Six abatement levels representing "increasingly stringent effluent qualities for petroleum refining industry wastewaters" were selected for detailed analysis.

139. Murray, R. E. Surface Coal Mining--1975. Min. Cong. J., v. 62, No. 2, February 1976, pp. 80-83.

Lack of capital and continuing cost increases due to inflation hurt the surface mining industry in 1976. Other industry constraints, such as problems in transportation systems development, contributed to the difficulties. About $21 billion in capital will be required for the industry to double production by 1985.

N

140. Nahas, R. S., M. R. Nahas, and C. E. Lummus. Naphtha Price Is Key to Aromatics Production in the Middle East. Oil and Gas J., v. 74, No. 26, June 28, 1976, pp. 143-146.

Naphtha price concessions are essential if production of aromatics in the Middle East is to be economically viable.

141. Nelson, W. L. Costimating. Oil and Gas J.

This series of articles furnishes information on plant costs.

Ref. No.	Title and Costimating No.	V.	No.	Date	Pages
141-1	28A. What Do Gas Processing Plants Cost?	74	20	May 17, 1976	156-158
141-2	28B. How Coking-Plant Costs and Yields Vary.	74	21	May 24, 1976	60- 62
141-3	27B. Aromatics Plant Costs Detailed.	74	al	July 19, 1976	134

142. _____. How the Nelson Refinery Construction-Cost Indexes Evolved. Oil and Gas J., v. 74, No. 48, Nov. 29, 1976, pp. 68-70.

This article answers the questions about the various Nelson cost indexes. A seven-part report covers the inflation index, the 1946 base prices, the quarterly itemized indexes, process unit costs, the history of operating cost indexes, miscellaneous (fabricated equipment indexes), and the detailed quarterly cost indexes since 1946.

143. _____. Hydrocracking--33: Catalyst Consumption Required in Desulfurizing Residua. Oil and Gas J., v. 74, No. 46, Nov. 15, 1976, pp. 72-74.

A major cost in desulfurizing residua is the cost of catalyst, especially with high-metal feeds. Wtih low-metal feeds, catalyst cost may range from 4 to 10 cents per barrel (1975 costs). With medium-metal feeds (150 ppm vanadium plus nickel), costs mount from 8 cents per barrel to as much as 40 cents per barrel.

144. _____. Nelson Cost Indexes. Oil and Gas J.

Refinery cost indexes appear monthly and consist of two parts: (1) Refinery construction cost indes and (2) refinery operating cost index.

Ref. No.	V.	No.	Date	Page
144- 1	74	1	Jan. 5, 1976	100
144- 2	74	5	Feb. 2, 1976	80
144- 3	74	9	Mar. 1, 1976	124
144- 4	74	14	Apr. 5, 1976	143
144- 5	74	18	May 3, 1976	243
144- 6	74	23	June 7, 1976	138
144- 7	74	27	July 5, 1976	108
144- 8	74	31	Aug. 2, 1976	133
144- 9	74	36	Sept. 6, 1976	126
144-10	74	40	Oct. 4, 1976	96
144-11	74	44	Nov. 1, 1976	85
144-12	74	49	Dec. 6, 1976	116

145. _____. Nelson Indexes--1: How the Nelson Refinery Construction-Cost Indexes Evolved. Oil and Gas J., v. 74, No. 48, Nov. 29, 1976, pp. 68-70.

This first article in a series of seven deals with the history of Nelson (inflation) index. Subsequent articles (see below) will explain the cost indexes and answer often-asked questions from readers.

146. _____. Nelson Indexes--2: Index Price Bases Explained. Oil and Gas J., v. 74, No. 50, Dec. 13, 1976, pp. 59-60.

The author explains the original 1946 prices which are the basis of his series of cost indexes.

147. _____. Nelson Indexes--3: Sources Cited for Quarterly Itemized Cost Indexes. Oil and Gas J., v. 74, No. 51, Dec. 20, 1976, p. 73.

This article is written to answer a reader's question: "We see your discussions of the Nelson indexes. What is the purpose of the indexes published each quarter?"

148. _____. Nelson Indexes--4: Where To Find Base Refinery Costs. Oil and Gas J., v. 74, No. 52, Dec. 27, 1976, pp. 199-200.

This article is written to answer a reader's question: "Will you list where the basic 1946 costs of refineries and process units were published and the indexes to go with them."

149. _____. Process Costimating. Oil and Gas J.

This series of articles furnishes information on process costs.

Ref. No.	Title and Costimating No.	V.	No.	Date	Pages
149- 1	58A. Refinery--Chemical Costs Updated	74	2	Jan. 12, 1976	109-110
149- 2	78B (revised). U.S. Refinery Yields (1889-1976).	74	6	Feb. 9, 1976	120
149- 3	82B (revised). Here Are U.S. Processing Types (1909-76).	74	7	Feb. 16, 1976	86
149- 4	68A. Use of TEL in U.S. Gasolines (Approximate).	74	8	Feb. 23, 1976	106
149- 5	159. Relating Investment, Productivity.	74	9	Mar. 1, 1976	120
149- 6	160. How To Find Current Cost Data.	74	10	Mar. 8, 1976	83- 84
149- 7	2A. Operating Costs Indexed for Refineries.	74	11	Mar. 15, 1976	129
149- 8	68A. Wages in U.S., Abroad Vary.	74	12	Mar. 22, 1976	66- 67
149- 9	161. Process Costimating Series Reviewed.	74	18	May 3, 1976	244
149-10	116A. Unit Utility Requirements--1.	74	24	June 14, 1976	73- 75
149-11	127C. Unit Utility Requirements--2: Here Are Process Steam, Heat, and Energy Needs.	74	25	June 21, 1976	122-124

150. _____. Productivity Costimating. Oil and Gas J.

Ref. No.	Title and Costimating No.	V.	No.	Date	Pages
150-1	69A. Materials Costs Rise Throughout World.	74	15	Apr. 12, 1976	64- 65
150-2	70A. Refinery Costs Compared Through the World.	74	17	Apr. 26, 1976	102-103
150-3	78. Here Are the Latest Indexes for Equal-Capability Plants.	74	28	July 12, 1976	60

151. _____. Quarterly Costimating. Oil and Gas J.

Appearing quarterly, this index presents costs of plants, processes, equipment, and associated items.

Ref. No.	Title	V.	No.	Date	Pages
151-1	True Cost Index is Abandoned.	74	1	Jan. 5, 1976	72- 73
151-2	Instrumentation Indexes Show Consistent 4-Year Rise.	74	14	Apr. 5, 1976	144-145
191-3	Nelson Index Components Show Consistent 2-Year Rise.	74	27	July 5, 1976	90- 91
191-4	Chemical Costs Show 4-Year Jump.	74	40	Oct. 4, 1976	110-111

152. _____. Questions on Technology. Oil and Gas J.

This series comprises discussions concerning various technological questions and answers.

Ref. No.	Title	V.	No.	Date	Pages
152- 1	Here Are More Stream-Time Efficiencies.	74	4	Jan. 26, 1976	160
152- 2	Tiny Refineries Serve Remote Rigs.	74	15	Apr. 12, 1976	92
152- 3	Cost-Estimating Courses Have Little Value.	74	17	Apr. 26, 1976	126
152- 4	World Refinery Yields Are Listed.	74	26	June 28, 1976	156
152- 5	Refining Costs Are Checked for 1976.	74	31	Aug. 2, 1976	137
152- 6	Tanker-Transportation Rates Explored.	74	32	Aug. 9, 1976	67- 68
152- 7	How Much To Deliver and Market Gasoline?	74	34	Aug. 23, 1976	
152- 8	Complexity-1: The Concept of Complexity.	74	37	Sept. 13, 1976	81- 82
152- 9	Complexity-2: Process Unit Complexity Factors Examined.	74	38	Sept. 20, 1976	202-204
152-10	Complexity-3: How To Apply Complexity.	74	39	Sept. 27, 1976	83- 84
152-11	Refinery Gasoline Prices Stated for New York.	74	41	Oct. 11, 1976	148

153. _____. Refinery Construction Costs Keep Climbing. Oil and Gas J., v. 74, No. 4, Jan. 26, 1976, p. 152.

The Nelson refinery (inflation) construction cost index is given. It rose some 52.4 points in 1975 and is projected to be rising continuously.

154. Newendorp, P. D. Decision Analysis--1: Risk Evaluation Helps Make Better Decisions. Oil and Gas J., v. 74, No. 42, Oct. 18, 1976, pp. 55-58.

The expected-value concept is fundamental for all the new decision-analysis techniques being developed. Importance of the technique is in including risk factors in economic evaluations. This is part 1 of a two-part article dealing with investment decisions in the petroleum industry.

155. Nolden, C. Judicious Maintenance Cuts Costs for Amax Coal. Coal Min. and Processing, v. 13, No. 3, March 1976, pp. 49-51.

Amax Coal Co. employs a surface mining equipment maintenance program that reduces overall costs. The program involves minimizing inventory, improving maintenance inspection, and planning for equipment downtime.

O

156. O'Brien, T. B. Drilling Costs: A Current Appraisal of a Major Problem. World Oil, v. 183, No. 5, October 1976, pp. 75-78.

Latest drilling cost studies conducted by the Independent Petroleum Association of America (IPAA) have led to a forecast of a leveling off of well drilling and equipping costs. Cost factors examined include rig day rates, rig moving, casing, drilling fluids, logging, cementing, and bits. The author has constructed a set of curves using well costs obtained firsthand from data covering 1968 to mid-1976.

157. O'Donnell, J. P. Offshore Pipeline Costs Skyrocket. Pipeline and Gas J., v. 203, No. 12, October 1976, pp. 17-20.

Increases in cost estimates on the High Island Offshore System (HIOS) and the Stingray projects indicate that costs are up 150 percent in a 3-year period, and that the range in component costs increases is from 22 to 372 percent. Detailed costs are given.

158. O'Hara, J. B. Coal Liquefaction. Hydrocarbon Processing, v. 55, No. 11, November 1976, pp. 221-226.

Coal liquefaction technology is complex and highly capital intensive, and major questions arise regarding its ability to compete economically with alternative fuel and energy sources. More economically attractive plants are expected to be defined as a result of intensive development work being conducted worldwide. This state-of-the-art report includes costs and descriptions of major processes.

159. Oil and Gas Journal. Bolivian Oil Strike Rated at 90 Million Bbl. V. 74, No. 38, Sept. 20, 1976, p. 130.

Bolivia's state-owned Yacimientos Petroliferos Fiscales Bolivianos (YPFB) has a major oil discovery at its 2 Monte Cristo northeast of the city of Santa Cruz, Santa Cruz Province. The structure is estimated by YPFB officials to have recoverable reserves of "more than 90 million bbl of oil, plus an undetermined amount of gas and condensate." The Bolivian Government is aiming for production of 200,000 barrels per day by 1980, and the YPFB has budgeted $3.5 billion for the oil sector during their current 5-year plan (1976-80).

160. _____. Construction of $600-Million U.S. Ethylene Plant Approved. V. 74, No. 49, Dec. 6, 1976, p. 69.

Britain's Imperial Chemical Industries Ltd., Union Pacific Corp. of the United States, and France's Solvay et Cie, have approved construction of a 1.2-billion-pound-per-year U.S. ethylene plant, expected to cost $600 million. Construction is scheduled to start in 1977 with startup planned for 1980. The plant will be located southwest of Champlin's Corpus Christi, Tex., refinery, which will supply liquid feed. ICI also has a 1.1-billion-pound-per-year ethylene plant under construction in England in partnership with British Petroleum Ltd.

161. _____. Crude-Tank Insulation Pay. V. 74, No. 45, Nov. 8, 1976, p. 182.

Insulating 10 tanks storing high-viscosity crude oil at Standard Oil Co. of California's Morro Bay facility has resulted in a saving in heating cost of nearly $500,000 per year. Installation cost of a 1-inch layer of spray-on rigid urethane foam was $500,000. Including a tax credit, the company will recover the expenditure in the first year. Before the insulation was installed, 58,400 barrels of low-sulfur fuel oil was required annually to heat the tanks. At $12 per barrel, the cost was $700,800 per year. Insulation has cut fuel use to 20,987 barrels per year, saving $448,950 per year, including tax credit.

162. _____. Drilling Under Way in Utah Program. V. 74, No. 44, Nov. 1, 1976, p. 95.

A 12-well, $2 million drilling program by Willard Pease Oil & Gas is under way in eastern Utah. Pease estimated the price of the gas at $1.50 per Mcf.

163. _____. Economic Upturn Seen Sparking Profit. V. 74, No. 18, May 3, 1976, pp. 115-118, 120.

Signs that recession is easing in the United States and abroad indicate better days ahead. Tables showing how 28 large U.S. companies fared financially in 1975 are broken down into the following headings: Total assets, net profit, return on total assets, return on stockholders' equity, capital and exploration expenditures, net liquids production, gas production, crude runs to stills, oil reserves, and gas reserves.

164. _____. Emission Standards Adopted for PVC and VCM Plants. V. 74, No. 44, Nov. 1, 1976, p. 31.

Strict standards limiting emissions from all existing and new vinyl chloride and allied plants have been adopted by the Environmental Protection Agency. Implementing the standard will cost the petrochemical industry an estimated $200 million for equipment plus $70 million per year in operating costs.

165. _____. EPA: Antipollution Plant $5.9 Billion by 1983. V. 74, No. 24, June 14, 1976, p. 49.

The petroleum industry will invest about $5.9 billion between 1974 and 1983, and spend about $1.9 billion per year for operation and maintenance, to meet Government air and water pollution cleanup regulations. EPA figures the added costs will result in an average product price increase in 1983 of about 1 cent per gallon.

166. _____. FEA May Reduce Gravity Differentials. V. 74, No. 38, Sept. 20, 1976, pp. 114-115.

The Federal Energy Administration's entitlements program provide incentives to U.S. refiners to run imported crude over domestic oil in some cases, causing refiners to cancel domestic contracts. Four tables comparing crude costs of domestic and foreign oils show differences in favor of foreign oil ranging from 23 cents to 60 cents per barrel.

167. _____. FPC Okays Three Offshore Lines. V. 74, No. 42, Oct. 18, 1976, pp. 28-29.

Gulf of Mexico pipeline projects valued at more than $112 million have been authorized by the Federal Power Commission. North High Island line will extend from Cameron Parish, La., to Galveston Block 255 off Texas and is expected to cost $56 million. The Blue Water line expansion will increase capacity to about 1.96 billion cubic feet per day. Cost of the project is estimated at $39.6 million.

168. _____. FPC To Keep $1.42 as New-Gas Price. V. 74, No. 45, Nov. 8, 1976, p. 144.

The Federal Power Commission, in a revised order, has decided to retain $1.42 per Mcf as the wellhead price for new natural gas. However, 1973-74 vintage gas is now 93 cents--down from $1.01 in the original order. The 1975-76 gas will carry a 4-cent-per-Mcf annual escalation, while the 1973-74 vintage will escalate 1 cent per Mcf.

169. _____. High Island Pipeline Okayed, Gas Sale Request Due Later. V. 74, No. 24, June 14, 1976, pp. 34-35.

The Federal Power Commission has approved a proposed 263-mile pipeline to carry natural gas from the High Island area of the Gulf of Mexico to markets in 29 States. The line is expected to cost $353.4 million and is designed to deliver nearly 1 billion cubic feet per day to five interstate pipelines.

170. _____. Hugh Capital Outlays Seen for Energy. V. 74, No. 47, Nov. 22, 1976, p. 76.

London banker believes capital requirements for energy development in industrialized world could hit $1.5 to $1.75 trillion during 1974-85. The lower amount allots about $700 billion to oil and gas, $50 billion to coal, and $750 billion to electrical power projects. Figures from Tosco show that with proper financing, shale oil could be produced and marketed profitably in the United States for about $12 per barrel. Of this selling price, $5.50 is production cost and $6.50 is capital service. The capital-service figure could go as high as $12 to $15, depending upon how the project is financed.

171. _____. Huge Outlay Seen for Cosurfactant Chemicals. V. 74, No. 38, Sept. 20, 1976, pp. 124-125.

Capital investments in cosurfactant chemicals for use in U.S. enhanced oil recovery could range up to $200 billion, a Union Carbide Corp. official estimates. Supply and demand for cosurfactant chemicals are expected to be in balance in 1980 without any enhanced-recovery use. But the chemical industry will have to add new capacity by 1983-85 in order to achieve enhanced oil-recovery production by 1985-87. Union Carbide believes an estimated 60 billion barrels of oil could be added to U.S. reserves by this method. Costs for the surfactant-polymer flooding process alone would be more than $300 million for 50 field tests, each covering 45 acres.

172. _____. Industry-U.S. Recovery Projects Grow. V. 74, No. 38, Sept. 20, 1976, pp. 118-119.

Joint enhanced-recovery projects have jumped to 27 in 1976 from 14 in 1975. Total costs have risen to $113 million from $54 million. Industry has provided $72.8 million of this amount. A tabulation of U.S. Government and industry enhanced-recovery projects shows location, date of contract, industry and Government costs, and industry participation. Discouraging results are reported from fracturing projects.

173. _____. Interprovincial's Sarnia-Montreal 520-Mile Extension Is Put Onstream. V. 74, No. 24, June 14, 1976, pp. 59-62.

Interprovincial Pipe Line Ltd.'s pipeline extension has gone into operation. Final cost estimates for the entire 30-inch line have been revised upward to $232 million. Deliveries are expected to be close to 250,000 barrels per day by the end of 1976.

174. _____. Koch, Ashland Slate New Oil Line to Twin Cities. V. 74, No. 40, Oct. 4, 1976, p. 58.

Koch Industries Inc. and Ashland Oil Co. plan to lay a new 478-mile, 24-inch crude line from Patoka, Ill., to their refineries in the Twin Cities, Minn., area. The $135 million project is expected to be completed in the fall of 1978. It will have six 5,460-horsepower pump stations.

175. _____. Mexico To Spend $11 Billion on Oil. V. 74, No. 40, Oct. 4, 1976, pp. 62-63.

Mexico's Petroleos Mexicanos (Pemes) has budgeted more than $11 billion over the next 6 years to expand the Nation's petroleum industry. A breakdown of the expenditures is given, with the largest single investment being $3.637 billion for expansion of drilling operations in oil-producing areas.

176. _____. New Floating Gas-Liquefaction Plant Designed. V. 74, No. 43, Oct. 25, 1976, p. 113.

A new design has been announced for floating natural gas liquefaction plants. The design was developed by the Marine and Process Plant divisions of Sener, one of Spain's engineering firms. Construction time for the basic floating plant (liquefaction capacity of 400 MMscf of gas) would be about 36 months. Estimated cost of a typical plant for delivery in 1979 would be about $300 million.

177. _____. New Group Plans $80-Million, 4-Year Arctic Islands Search. V. 74, No. 47, Nov. 22, 1976, pp. 74-75.

A four-company consortium has been set up to carry out an $80 million, 4-year exploration program in the Canadian arctic islands. Sources indicate the group hopes to drill about 20 exploratory wells at a cost of about $4 million per well.

178. _____. New-Lease Yield on OCS Seen Prolific. V. 74, No. 51, Dec. 20, 1976, p. 41.

U.S. leases awarded through 1978 should yield 972 million barrels of crude oil and 2.466 trillion cubic feet of gas in 1985, Arthur D. Little, Inc., predicts. Capital requirements for this exploration and development are discussed.

179. _____. New Trends Seen in Olefin Feedstocks. V. 74, No. 42, Oct. 18, 1976, pp. 40-41.

Ethane and liquefied petroleum-gas are ending naphtha's reign as the premier feedstock for olefin production in Western Europe. In the United States, the situation is nearly reversed. A chart gives feedstock costs, credit for byproducts, fixed production costs, return on investment, and total ethylene production costs for a 450,000-ton-per-year plant, by location and feed.

180. _____. Northwest Files Alaska Gas-Line Plan Wtih FPC. V. 74, No. 29, July 19, 1976, p. 46.

Northwest Pipeline Corp. has filed its proposed Alaskan gas-pipeline proposal with the Federal Power Commission. It contends it can transmit gas sooner and cheaper than competing proposals. A 731-mile, 42-inch line along the Alcan highway would have an initial capacity of 1.2 billion cubic feet per day, expanding to an average of 2.4 billion cubic feet per day over a 2-year period. The Alaskan portion of the line would cost an estimated $2.3 billion in 1975 dollars. Cost of service to transport the gas to the United States-Canadian border would be $1.43 per MMBtu, compared with $1.70 for the Arctic Gas project.

181. _____. Phillips Increases Stripper Prices by as Much as $1.70. V. 74, No. 38, Sept. 20, 1976, p. 122.

Phillips Petroleum Co. posted price increases in September 1976 ranging from about $1.20 to $1.70 per barrel for U.S. stripper crude as a result of legislation freeing such oil from Federal price and allocation controls. This action was taken in the belief that the Federal Energy Administration will treat stripper crude as imports for purpose of entitlements.

182. _____. Profits Growth Slips in Third Quarter. V. 74, No. 46, Nov. 15, 1976, pp. 33-34.

Based on an analysis of 25 U.S. companies, oil-company profits for the third quarter of 1976 are up only 6.7 percent, compared with 30.2-percent and 15.1-percent increases reported in the first and second quarters, respectively. Article includes a tabulation of the profit picture for 25 companies, which shows the net earnings for the first 9 months of 1976 with the percent of change from 1975, and the net earnings for the third quarter of 1976 with the percent of change from 1975.

183. _____. Synfuels Development in U.S. Dealt New Setback. V. 74, No. 40, Oct. 4, 1976, pp. 51-55.

The House of Representatives by a one-vote margin on September 23, 1976, refused to consider a measure that would have authorized $4 billion in loan guarantees in a 2-year program to aid commercialization of synfuel processes. Discussion of most of the major liquefaction, gasification, and shale oil processes identifies sites and gives some cost figures.

184. _____. U.S. Briefs: Oil Shale. V. 74, No. 30, July 26, 1976, p. 88.

The Bureau of Mines let a $1.6 million contract to Rowan Drilling U.S. to drill a 2,350-foot hole in a western Colorado oil shale deposit. Expected to be completed in the summer of 1977, the 8-foot-diameter hole will give geological and environmental information on deep oil shale deposits in the Piceance basin. Another Bureau of Mines contract for $262,632 went to Cleveland Cliffs Iron Co. for design, layout, and cost assessments of an experimental oil shale mine.

185. _____. U.S. Briefs: Transportation. V. 74, No. 38, Sept. 20, 1976, p. 126.

Tejas Gas Corp., Corpus Christi, Tex., has reached tentative agreement to gather and deliver east Texas natural gas to Lone Star Gas Co., Dallas. The intrastate agreement would require Tejas to lay 35 miles of 10-inch main line, with gathering lines, in Rusk and Panola Counties at a cost of about $3.6 million. System capacity would be 40 MMscfd, with construction time estimated at 150 days.

186. Osterland, F. C. Automatic Setting Regulation - Key to Greater Crushing Plant Profitability. Pit and Quarry, v. 68, No. 9, March 1976, pp. 71-73.

In a crushing plant for aggregates and stone, increasing productivity means higher profitability. Methods for improving productivity are outlined, and related revenue increases are shown.

P

187. Patton, P. W. How To Find the Lowest-Cost Vacuum System. Chem. Eng., v. 83, No. 3, Feb. 2, 1976, pp. 84-88.

The chemical process industries employ many processes that require high-vapor-flow vacuums created by various types of pumps. The authors attempt to demonstrate economy in the selection of a system under environmental and fuel cost constraints.

188. Pavletic, R. P., A. C. Skinner, and D. Stewart. Why Dual Ethylene Unit Compressors? Hydrocarbon Processing, v. 55, No. 10, October 1976, pp. 135-138.

Economic analysis shows that dual compressor trains in all major services give lower overall capital investment and great reliability. The total installed cost of the complex--taking into account the ethylene unit, energy systems, and ethylene storage investment--will be approximately $6 million less for a dual-compressor-train plant than for a single-compressor-train plant.

189. Pikulik, A. Selecting and Specifying Valves for New Plants. Chem. Eng., v. 83, No. 19, Sept. 13, 1976, pp. 168-190.

Valves make up 20 to 30 percent of the piping cost for a plant, depending on the process; the cost of a given type and size of valve can vary 100 percent, depending on its construction. Thus the selection of valves is extremely important to the economics, as well as the operation, of process plants. This report discusses ways to decide on a valve type, and contains data on cost versus construction features, as well as on the valve's materials of construction.

190. Pipeline and Gas Journal. Dome-Cochin Aims for 1977 Completion on 2000-Mile Project. V. 203, No. 13, November 1976, p. 9.

A 1,997-mile, 12-inch pipeline extending from Fort Saskatchewan, northeast of Edmonton, Alberta, to near Toledo, Ohio, will cost an estimated $160 million for the Canadian portion and $140 million for the U.S. portion. Initial capacity of the line will be 75,000 barrels per day, and it will have 11 pump stations in Canada and 22 in the United States.

191. Pit and Quarry. Solid Film Lubricants Can Cut Maintenance Cost. V. 68, No. 4, October 1976, pp. 62-65, 83.

The concept of preventive maintenance, and the actual cost savings derived from the use of solid film lubricants are important considerations in heavy-duty industries. Solid film lubricants markedly reduce the need for lubricant replenishment. Tables show cost comparisons between conventional and solid film lubricants. There were annual $6,350 cash savings plus the crushing of more than 25,000 tons more stone in one case, and an annual savings of $9,786 plus reduced downtime costs in another case.

192. Ponder, W. H., and G. G. McGlamery. SO_2-Control Methods Compared. Oil and Gas J., v. 74, No. 50, Dec. 13, 1976, pp. 60-68.

Balancing coal use and environmental protection is a complex energy-environment-economic problem. Availability and economics are dominant in evaluating competing technologies. Relative costs of different processes are detailed.

193. Porter, J. J., and C. Brandon. Zero Discharge as Exemplified by Textile Dyeing and Finishing. Chemtech, v. 6, No. 6, June 1976, pp. 402-407.

This article on waste water treatment gives capital investment, operating costs, and recycle potential for textile wastes. The authors estimate that treating 2 million gallons of waste water per day will cost $2,400.

194. Pujado, P. R., J. R. Salazar, and C. V. Berger. Cheapest Route to Phenol. Hydrocarbon Processing, v. 55, No. 3, March 1976, pp. 91-95.

Estimated investment costs are given for 100,000-metric-ton-per-year phenol plants.

Q

195. Quang, D. V., P. Bonnefond, L. Kerdraon, and J. W. Andrews. Spent Oil Reclaimed Without Acid. Hydrocarbon Processing, v. 55, No. 12, December 1976, pp. 130-131.

A new spent-oil-reclaiming scheme omits the sulfuric acid treatment step. The scheme uses the IFP propane clarification process developed by Institut Français du Pétrole (IFP). A table gives economics for IFP regeneration of used lubricants.

196. Quinlan, R. M., and S. Venkatesan. Economics Count in Coal Preparation Planning. Coal Min. and Processing, v. 13, No. 9, September 1976, pp. 84-86, 88.

Capital and operating costs associated with different types of coal cleaning circuitry are discussed in terms of rate of return on investment. Cost information is presented in both narrative and tabular form.

R

197. Reber, S. A., R. M. Nadkarni, R. W. Hyde, A. H. Schutte, and R. P. Stickles. Liquefy Coal To Petrochemical Feed. Hydrocarbon Processing, v. 55, No. 11, November 1976, pp. 229-234.

The Arthur D. Little (ADL) coal liquefaction process lists the following advantages over H-Coal and Synthoil processes: (1) The absence of a need for catalysts--which cost roughly $5 million per year (60 cents per barrel) for H-Coal, (2) rapid scale-up with the conventional hardware and unit operations used, (3) no high-pressure slurry handling, (4) a Syncrude product rather than a heavy fuel oil, and (5) no costly hydrogen compression if solvent hydrotreating can be operated at 1,200 psig. A description of the process includes block flow diagrams and tables showing utility requirements, steam requirements, capital investment, and annual operating costs.

198. Reynolds, J. A. Saving Energy and Costs in Pumping Systems. Chem. Eng., v. 83, No. 1, Jan. 5, 1976, pp. 135-138.

Lower costs for pumping systems are achieved through saving horsepower by investing in more efficient pumps. Examples cited show that the entire system must be considered in order to make a good choice of pumps. Tables present specific comparisons in dollar costs and savings.

199. Robitaille, D. R., and J. G. Bilek. Molybdate Cooling-Water Treatments. Chem. Eng., v. 83, No. 27, Dec. 20, 1976, pp. 77-78, 80.

When used in multicomponent formulations, molybdates provide nontoxic corrosion inhibition at a cost competitive with other nonchromate treatments. A table gives costs derived from the raw materials used in several typical formulations, each of which provides about the same degree of corrosion protection.

200. Rock Products. Increased Cement Shipments Require Pricing Policy Support. V. 79, No. 12, December 1976, pp. 47-48.

Final figures for 1976 show a consumption gain for cement of about 6 percent. The outlook for 1977 continues to be encouraging. Several major projects that have been announced are listed. Capital investment and capacity are listed for the projects, which are located in the United States and in Canada.

201. Rosenzweig, M. D. Copper Makers Look to Sulfide Hydrometallurgy. Chem. Eng., v. 83, No. 1, Jan. 5, 1976, pp. 79-81.

Capital and operating costs are compared for copper processing plants using a leaching or smelting technique. Capital costs are estimated to be $2,000 per annual ton of capacity for a 50,000-ton-per-year plant.

202. Ross, A. P. Rediscovering Lead--Part III. Chem. Eng., v. 83, No. 24, Nov. 22, 1976, pp. 175-178.

This final article of a three-part serial discusses the costs of lead fabrication and the mechanical performance of the metal under conditions of pressure, temperature, vibration, and abrasion. The two previous articles (Nov. 24, 1975, and Aug. 2, 1976) described the economic factors in lead's resurgent popularity, strengths and applicability of the available lead composites, and the behavior of lead in corrosive and erosive environments.

203. Rothrock, R. Downhole Maintenance Costs Nearing $600,000,000 This Year. Petrol. Eng., v. 48, No. 8, July 1976, pp. 18-20.

A breakdown of crude oil production operating and maintenance costs is given. Other items discussed include crude price impact and labor costs.

S

204. Schroeder, W. C. Solid Phase Hydrogenation Cuts Cost. Hydrocarbon Processing, v. 55, No. 1, January 1976, pp. 131-133.

Capital and operating costs are given for equipment used in coal hydrogenation and other coal conversion processes. Feeders, coolers, pumps, and heat exchangers are among the items discussed. Operating cost estimates are also considered.

205. Scott, J. Deep Well Costs Soar as Completions Decline. Petrol. Eng., v. 48, No. 4, March 1976, pp. 25-30.

Tables giving deep-oil-well drilling data are presented for various States. Drilling costs per foot and other variables such as bit and mud costs are given.

206. Serrurier, R. Prospects for Marketing Coal Gasification Byproducts. Hydrocarbon Processing, v. 55, No. 9, September 1976, pp. 253-257.

Byproduct streams have the potential for improving economics of coal gasification processes. This article presents a process description and a cost estimate for a plant (using a Lurgi gasification process) to produce byproducts of a quality equivalent to current market standards.

207. Sisson, W. Nomogram Estimates Fuel Savings by Economizer or Air Preheater. Power Eng., v. 80, No. 4, April 1976, p. 97.

A powerplant boiler can use less fuel if an economizer, or air preheater, is used with it. A nomogram shows how to estimate fuel savings in dollars for different size boilers.

208. Smith, A. E., and G. T. Schaefer, Jr. Heat Recovery From Multi-Turbine Installations. J. Petrol. Technol., v. 28, June 1976, pp. 639-644.

To develop better energy recovery systems, Exxon Co., U.S.A., recently completed two multiturbine energy recovery systems to supply heat in natural gas processing plants. Design concepts and objectives intended to serve as a guide for future applications are outlined.

209. Smith, R. S. Injection Pump Study Can Cut Costs. Oil and Gas J., v. 74, No. 8, Feb. 23, 1976, pp. 99-102.

Water injection systems for enhanced oil recovery are compared. Capital and operating costs are given for different systems.

210. Spitz, P. H. Propylene--Key Questions for the Future. Chem. Eng. Prog., v. 72, No. 11, November 1976, pp. 13-20.

Propylene supply and demand is expected to be in balance until 1985. This article discusses propylene sources, the history of prices, new-plant construction costs, and the possible reaction of prices to the expected future supply-demand situation.

211. Steele, R. D. Engineering and Economics Used To Optimize Artificial-Lift Methods. Oil and Gas J., v. 74, No. 49, Dec. 6, 1976, pp. 107-110, 112, 114, 116.

Three types of artificial lift were chosen to optimize production in Judy Creek reservoirs, located 130 miles northwest of Edmonton, Alberta, using detailed engineering and economic analyses. One section of the article deals with economics.

212. Steinberg, M. Substituting Polyketones and Polysulfones for Polyethylene. Chem. Eng. Prog., v. 72, No. 9, September 1976, pp. 75-79.

There is a sizable incentive to reduce raw material cost for basic polymer manufacture. The polyketones and polysulfones, synthesized from ethylene and waste materials, offer one such possibility. Capital requirements are discussed, and a table shows a preliminary cost estimate for polyketone production by radiation-induced copolymerization. The possible savings in gas and oil reserves by substituting an essentially low-cost waste product, such as CO or SO_2, coupled with a high commodity market for polyethylene, present a strong incentive for pursuing the required development effort.

213. Strickland, J. R. Titanium Heat Exchangers Can Be Worth Their Cost To Cut Downtime. Oil and Gas J., v. 74, No. 36, Sept. 6, 1976, pp. 101-102.

Titanium, once considered too costly for most applications, is becoming recognized as a means of eliminating costly refinery shutdown for repairs caused by corrosion and fouling in heat exchangers.

Added economics are gained from its antifouling characteristics throughout the life of an exchanger. A table gives some typical capitalized cost comparisons for titanium and other materials.

214. Summerell, H. Recovering Energy From Stacks. Chem. Eng., v. 83, No. 7, Mar. 29, 1976, pp. 147-148.

Money and material savings are achieved when heat recovery and air pollution control are combined in chemical plants. Examples are given that demonstrate the cost effectiveness of energy recovery and efficient use.

215. Sze, M. C., and A. P. Gelbein. Make Aromatic Nitriles This Way. Hydrocarbon Processing, v. 55, No. 2, sec. 1, February 1976, pp. 103-106.

This oxidative Lummus ammonolysis process promises top-quality aromatic nitriles at lowest capital investment and operating costs. Tables give process economic data.

T

216. Thomson, S. J., and R. H. Crow. Energy Cost of NO_x Control. Hydrocarbon Processing, v. 55, No. 5, May 1976, pp. 95-97.

Cutting NO_x emissions by decreasing firing temperature in gas turbines increases fuel consumption. A better method for controlling these emissions is steam or water injection into the combustion chamber. However, capital and operating costs of the injection equipment raise the price of electricity generated about 4 to 6 percent.

217. Topping, R. E. Computer Program Useful in Unit Operation Selection and Cost Estimation. Water and Sewage Works, v. 123, No. 11, November 1976, pp. 96-99.

A computer program, PROCS, selects the most cost effective treatment scheme that would satisfy specified effluent limitations. A printout of PROCS for a sample situation in which secondary treatment, nitrification, chlorination, and postaeration are required is shown in tabular form. Cost calculations for the activated sludge process are shown as an example of the economic analysis for the unit processes. Total present worth and average annual cost for the 2.2-million-gallon-per-day treatment system are $3.963 million and $0.342 million, respectively.

218. Tost, D. Syncrude Vows Environmental Responsibility. Hydrocarbon Processing, v. 55, No. 10, October 1976, pp. 102-106.

Faced with the most stringent environmental regulations in Canada, the giant $2 billion Syncrude Canada Ltd. project in Alberta's Athabasca Tar Sands is involved in one of the most comprehensive environmental protection programs in Canada's industrial history. Syncrude is spending $300 million on environmental research and pollution control systems.

219. Truby, R. Reverse Osmosis for Boiler Feedwater Treatment. Power Eng., v. 80, No. 12, December 1976, pp. 58-60.

Reverse osmosis systems combined with demineralizers have proved cost effective in powerplant feedwater use with everything from city water to municipal sewage since early successes were reported in 1971. Reverse osmosis also has been found effective when used without demineralizers to treat feedwater for intermediate-pressure boilers.

220. Tucker, J. C. Tires Are Your Single Largest Operating Cost. Rock Products, v. 79, No. 3, March 1976, pp. 68-70.

The author estimates that 20 to 50 percent of the operating costs for large off-highway trucks is spent on tires. Examining such factors as tire construction, load, speed, and pressure, he is able to determine where cost minimization will occur.

U

221. Uchida, H. HDS Unit Affects H_2 Plant Conditions. Oil and Gas J., v. 74, No. 41, Oct. 11, 1976, pp. 126, 131-136.

A study based on commercial units in Japan shows that the best design values for a hydrogen plant alone are significantly different from those for a plant in residual desulfurization service. The unit price for raw materials and utilities used to make economic evaluations in 20 cases for both hydrogen-manufacturing cost and low-sulfur residual-oil refining cost are given in tabular form.

222. Uchiyama, T. Cooling Tower Estimates Made Easy. Hydrocarbon Processing, v. 55, No. 12, December 1976, pp. 93-96.

The author presents a "new, fast, and accurate" calculation method for cooling tower sizing, cost, and performance estimation.

V

223. Vierath, D. R., and W. W. Walkley. Costs of Meeting Clean Air Requirements. Power Eng., v. 80, No. 9, September 1976, pp. 64-69.

Rigorous interpretation and administration of Significant Deterioration and Best Available Control Technology provisions of Clean Air Act Amendments being considered by Congress may add substantially to capital requirements and operating costs of powerplants, and might be counterproductive. Alternate control strategies could be used to improve air quality at much more reasonable costs to utilities and consumers.

224. Voltin, M. J., and P. S. Schmidt. Fuel Conservation and the Breeder Reactor. Mech. Eng., v. 98, No. 3, March 1976, pp. 28-33.

The generation of enormous additional amounts of electric power is taking form as one of the major problems that our society must resolve in the next few decades. This article analyzes the influence of the breeder reactor timetable on national demand for coal, oil, gas, and enriched uranium as power generation fuels for the period 1986-2010. Costs are tabulated.

W

225. Wearly, W. L. Implications of Escalating Capital and Development Costs. Min. Cong. J., v. 62, No. 6, June 1976, pp. 33-40.

Using various economic indices, the author shows how costs have increased for the mining industry at an extremely high rate. Specific pieces of equipment are used to illustrate this point.

226. Webster, H. A. The Costs of Corrosion: A Perspective. J. APCA, v. 26, No. 4, April 1976, pp. 302-303.

Corrosion of materials costs the economy billions of dollars each year. Estimates of damages are considered.

227. West, E. R. In West Texas' Delaware Basin...Improved Drilling Is a Result of Sound Engineering. World Oil, v. 183, No. 7, December 1976, pp. 57-59.

The use of well-established engineering practices and proper planning resulted in an area drilling record. In the West Rojo Caballos area of the Delaware Basin in West Texas, a 21,650-foot well was drilled 30 days faster than the previous record. Bit and mud costs, which were reduced significantly, are discussed.

228. West, J. U.S. Operators Plunge Big in Baltimore Canyon Sale. Oil and Gas J., v. 74, No. 34, Aug. 23, 1976, pp. 45-49.

Oil companies bid $1.1 billion for leases on 101 of 154 tracts offered in the Baltimore Canyon trough off New Jersey and Delaware. The sale area could contain 400 million to 1.4 billion barrels of oil and 2.6 to 9.4 trillion cubic feet of gas, the Interior Department estimates. A tabulation of the 10 top bidders shows the number of tracts acquired and the amounts of the bids.

229. Wilson, H. M. Beefed-Up Tanker Fleets Readied for N. Slope Oil. Oil and Gas J., v. 74, No. 24, June 14, 1976, pp. 23-26.

This article estimates tanker price to U.S. ports in a range of 50 cents to $1 per barrel, possibly higher. If the tanker cost from Valdez is $1 and the pipeline cost from Prudhoe Bay to Valdez is $4.50, the wellhead price of the crude in the field would have to be in the neighborhood of $7 to undersell the foreign competition.

230. Wilson, W. B., and J. M. Kovacik. Electricity: Generate or Buy? Hydrocarbon Processing, v. 55, No. 12, December 1976, pp. 75-78.

The integration of steam turbines to supply both process heat and power has proven to be economical. An example shows that a conventional fossil-fuel-fired electric utility plant having a system heat rate of 10,000 Btu per kilowatt-hour requires 2-1/2 times as much fuel to generate 44 megawatts as the in-plant-generation alternative.

231. Wimer, W. E., and R. E. Feathers. Oxygen Gives Low Cost VCM. Hydrocarbon Processing, v. 55, No. 3, March 1976, pp. 81-84.

Costs are compared for different processes that manufacture vinyl chloride monomer. An oxygen process gives the lowest cost.

232. Winter, O., and M. T. Eng. Make Ethylene From Ethanol. Hydrocarbon Processing, v. 55, No. 11, November 1976, pp. 125-133.

While not competitive when large-scale petroleum-based ethylene is available, ethanol-based ethylene has a definite place in the economics of developing countries for low-cost entry into petrochemicals when raw materials are available. Technical details are given, and one section of the article presents the economics of the process.

233. Witwer, J. G., K. K. Ushiba, and K. T. Semrau. LNG: Energy Conservation With LNG Cold. Chem. Eng. Prog., v. 72, No. 1, January 1976, pp. 50-55.

When liquefied natural gas is returned to a gaseous state, some material must lose heat for the conversion to occur. This cold can be used in a number of ways, most of which save energy. Cost savings and other advantages are reviewed.

234. Woodhouse, G. J. Ethylene Feedstocks To Change in Europe as Supply Fluctuates. Oil and Gas J., v. 74, No. 31, Aug. 2, 1976, pp. 96-98, 103-104.

Gas oil may account for more than 25 percent of the total petrochemical feedstock requirements in Europe by the late 1970's. This change will have a significant impact on production of ethylene and plant design. The article includes a table giving the cost of producing ethylene from various feedstocks.

235. World Oil. Drilling, Completion Costs Should Level Off This Year. V. 182, No. 3, Feb. 15, 1976, pp. 81, 84-85.

Price indexes for items used for drilling and equipping U.S. wells, contractor payments, and oilfield tubular goods are shown. Detailed examples are given of the costs of drilling a well in 1973 and 1975. Other examples, less detailed, show how costs rose in selected areas.

236. _____. How Dome Plans To Drill in the Arctic's Beaufort Sea. V. 183, No. 1, July 1976, pp. 51-55.

Operations on what was projected to be the most expensive well ever drilled were expected to begin in August 1976. The Tingmiark hole will be drilled by Dome Petroleum Ltd. and Gulf Oil Canada Ltd. in the Beaufort Sea of northern Canada. This article discusses anticipated costs, special environmental precautions, and the drilling program. Per-well cost is expected to be about $35 million if drilling can be completed in one season. If two drilling seasons are required, the cost could approach $50 to $60 million.

237. _____. 10-Year Industry Investment Must Total $955 Billion. V. 182, No. 5, April 1976, pp. 67-69.

The need to find more oil and to search for it in expensive places, coupled with continuing inflation, means that the world petroleum industry must invest $480 billion to find and develop new reserves in the next 10 years. An additional $475 billion will be needed to transport, process, and market all the petroleum which the world will require. This article is a synopsis of a report by the Chase manhattan Bank's Energy Economics Division.

238. _____. A World of Oil: Chase Report. V. 183, No. 7, December 1976, p. 21.

Expenses are up, net income is down, and the Chase group of oil companies dipped into working capital for $2.1 billion in 1975 in addition to borrowing $10.1 billion. That is the gist of a report issued by Chase Manhattan Bank covering operations of 29 major oil companies for 1975. Total figures for operating costs, charges against income, and earnings are given.

239. Wright, T. R., Jr. New Developments Will Cut Drilling Time, Expense. World Oil, v. 183, No. 5, October 1976, pp. 79-83.

New ideas in rig design, a unique method of driving conductor pipe, two recent developments in offshore drilling, and a complete cementing system packaged in one unit highlight the latest developments in drilling technology. A discussion of new tools and techniques which the industry is using to reduce waste of time and materials is presented.

Y

240. Yamaguchi, M., K. Matsushita, and K. Takami. Remove NO_x From HNO_3 Tail Gas. Hydrocarbon Processing, v. 55, No. 8, August 1976, pp. 101-106.

Oixdes of nitrogen consist mainly of nitrogen monoxide and nitrogen dioxide. In Japan, stringent regulation on NO_x emission have been applied to sources of all kinds. This article compares a number of known techniques and costs of selective and nonselective processes.

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